IJCSIS Vol. 9 No. 4, April 2011
ISSN 1947-5500

International Journal of Computer Science & Information Security

Editorial
Message from Managing Editor

International Journal of Computer Science and Information Security (IJCSIS is a peer reviewed journal that is committed to timely publication of original research, surveying and tutorial contributions on the analysis and development of computing and information engineering. The journal is designed mainly to serve researchers and developers, dealing with information security and computing. Papers that can provide both theoretical analysis, along with carefully designed computational experiments, are particularly welcome.

IJCSIS editorial board consists of several internationally recognized experts and guest editors. Wide circulation is assured because libraries and individuals, worldwide, subscribe and reference to IJCSIS. The Journal has grown rapidly to its currently level of over 1,000 articles published and indexed. The journal is published monthly with distribution to librarians, universities, research centers, researchers in computing, and computer scientists. The journal maintains strict refereeing procedures through its editorial policies in order to publish papers of only the highest quality.

Other field coverage includes: security infrastructures, network security: Internet security, content protection, cryptography, steganography and formal methods in information security; multimedia systems, software, information systems, intelligent systems, web services, data mining, wireless communication, networking and technologies, innovation technology and management. (See monthly Call for Papers)

IJCSIS is published using an open access publication model, meaning that all interested readers will be able to freely access the journal online without the need for a subscription.

On behalf of the Editorial Board and the IJCSIS members, we would like to express our gratitude to all authors and reviewers for their hard and high-quality work.

Available at http://sites.google.com/site/ijcsis/

IJCSIS Vol. 9, No. 4, April 2011 Edition

ISSN 1947-5500 © IJCSIS, USA.

Abstracts Indexed by (among others):

IJCSIS EDITORIAL BOARD

TABLE OF CONTENTS

26. Paper 12031101: Implementation of Direct Processor Access in Transient Faulty Nodes (pp. 162-166)

P. S. Balamurugan, B. E., M. E., Research Scholar , Anna university, Coimbatore
Dr. K.Thanushkodi, B. E., M. Sc (Engg),Ph. D, Director , Akshaya College of Engineering and Technology, Coimbatore

Dynamic Rough Sets Features Reduction

Walid MOUDANI[1], Ahmad SHAHIN[2], Fadi CHAKIK[2], and Félix Mora-Camino[3]
[1]*Lebanese University, Faculty of Business, Dept. of Business Information System, Lebanon*
[2] *LaMA – Liban, Lebanese University, Lebanon*
[3] *Air Transportation Department, ENAC, 31055 Toulouse, France*

***Abstract*—Nowadays, and with the current progress in technologies and business sales, databases with large amount of data exist especially in retail companies. The main objective of this study is to reduce the complexity of the classification problems while maintaining the prediction classification quality. We propose to apply the promising technique Rough Set theory which is a new mathematical approach to data analysis based on classification of objects of interest into similarity classes, which are indiscernible with respect to some features. Since some features are of high interest, this leads to the fundamental concept of "Attribute Reduction". The goal of Rough set is to enumerate good attribute subsets that have high dependence, discriminating index and significance. The naïve way of is to generate all possible subsets of attribute but in high dimension cases, this approach is very inefficient while it will require $2^d - 1$ iterations. Therefore, we apply Dynamic programming technique in order to enumerate dynamically the optimal subsets of the reduced attributes of high interest by reducing the degree of complexity. Implementation has been developed, applied, and tested over a 3 years historical business data in Retail Business. Simulations and visual analysis are shown and discussed in order to validate the accuracy of the proposed tool**

Keywords- Data Mining; Business Retail; Rough Sets; Attribute Reduction; Classification; Dynamic Programming.

I. INTRODUCTION

Retail Business (RB) Company looks for increasing its benefit by providing all facilities services to its customers. The estimated benefits amount to several millions of dollars when the Retail Business Company organizes and offers to its customers the most related items. The RB Company stores and generates tremendous amounts of raw and heterogeneous data that provides rich fields for Data Mining (DM) [1, 2]. This data includes transactions Details (customers/providers) describing the content such as items, quantity, date, unit price, reduction, and other events such as the holidays, special activities, etc. Moreover, the profile of customers and their financial transactions contribute in personalizing some special services to each customer. This leads the research community to study deeply this field in order to propose a new solution approach for these companies. Moreover, these companies should analyze their business data in order to predict the appropriate services to be proposed to its customers. This approach is one of the main objectives of the retailer company. In order to build such a non trivial model, many researches were carried out on the feasibility of using the DM techniques, which raised from the need of analyzing high volumes of data collected by the retailer companies and related to different kinds of transactions between the company and its customers/providers. Our contribution aims to reduce the complexity of the classification process by reducing the number of attributes that should be considered in order to discover the fruitful knowledge required by decision makers of RB.

The 1990s has brought a growing data glut problem to many fields such as science, business and government. Our capabilities for collecting and storing data of all kinds have far outpaced our abilities to analyze, summarize, and extract knowledge from this data [9]. Traditional data analysis methods are no longer efficient to handle voluminous data sets. How to understand and analyze large bodies of data is a difficult and unresolved problem. The way to extract the knowledge in a comprehensible form for the huge amount of data is the primary concern. DM refers to extracting knowledge from databases that can contain large amount of data describing decisions, performance and operations. However, analyzing the database of historical data containing critical information concerning past business performance, helps to identify relationships which have a bearing on a specific issue and then extrapolate from these relationships to predict future performance or behavior and discover hidden data patterns. Often the sheer volume of data can make the extraction of this business information impossible by manual methods. DM treats as synonym for another popularly used term, Knowledge Discovery in Databases. KDD is the nontrivial process of identifying valid, novel, potentially useful and ultimately understandable patterns in data. DM is a set of techniques which allows extracting useful business knowledge, based on a set of some commonly used techniques such as: Statistical Methods, Case-Based Reasoning, Neural Networks, Decision Trees, Rule Induction, Bayesian Belief Networks, Genetic Algorithms, Fuzzy Sets, Rough Sets, and Linear Regression [4, 36]. DM commonly used in a variety of domains such as: marketing, surveillance and fraud detection in telecommunications, manufacturing process control, the study of risk factors in medical diagnosis, and customer support operations through a better understanding of customers in order to improve sales.

In commerce, RB is defined by buying goods or products in large quantities from manufacturers or importers, either directly or through a wholesaler, and then sells individual items or small quantities to the general public or end user customers. RB is based on the sale of goods from fixed

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

locations, these locations could be physical (shop or store) and/or virtual over the web. Retailing may include several types of services that can go along with the sale, such as delivery of goods, processing and tracking loyalty card functionality. The process goes from buying products in large quantities from manufacturers, and then sells smaller quantities to the end-user. From a business perspective, DM is mainly used in the Customer Relationship Management (CRM) area, specifically marketing. DM today's applications provide the tool for retailers or decision maker to get precious knowledge that covers the requested field of interest and make sense of their customer data and apply it to business such as: the sales/marketing domain and other business-related areas [4]. It contributes to predict customer purchasing behavior and perform target marketing by using demographic data and historical information, to drive sales suggestions for alternate or related items during a purchase transaction, to identify valuable customers, allowing the CRM team to target them for retention, to point out potential long-term customers who can be a potential target through marketing programs [36], to identify people behavior who are likely to buy new products based on their item categories purchased, to assess the products which are bought together.

This paper is organized as follows: in section 2, the background of DM and its relationship with RB is presented and highlighted by specifying the main major problems faced by retailer. In section 3, we present the Rough Sets (RS) technique and the Rough Sets Attribute Reduction (RSAR) problem followed by a general overview of the literature and a mathematical formulation. Therefore, in section 4, we present a new dynamic solution approach for the RSAR problem based on the Dynamic Programming technique followed by a study of its complexity. In section 5, we describe our solution approach through a numerical example using some well-known datasets followed by discussion and analysis of the results obtained. And finally, we ended by a conclusion concerning this new approach and the related new ideas to be tackled in the future.

II. ROUGH SET THEORY

Pawlak has introduced the theory of RS which is an efficient technique for knowledge discovery in databases [33, 34]. It is a relatively new rigorous mathematical technique to describe quantitatively uncertainty, imprecision and vagueness. It leads to create approximate descriptions of objects for data analysis, optimization and recognition. It is shown to be methodologically significant in the domains of Artificial Intelligence and cognitive science, especially in respect of the representation and of the reasoning with imprecise knowledge, machine learning, and knowledge discovery. In RS theory, the data is organized in a table called decision table. Rows of the decision table correspond to objects, columns correspond to attributes, and class label indicates the class to which each row belongs. The class label is called as decision attribute, the rest of the attributes are the condition attributes. Therefore, the partitions/classes obtained from condition attributes are called elementary sets, and those from the decision attribute(s) are called concepts. Let's consider C for the condition attributes, D for the decision attributes, where $C \cap D = \phi$, and t_j denotes the j^{th} tuple of the data table. The goal of RS is to understand or construct rules for the concepts in terms of elementary sets, i.e., mapping partitions of condition attributes to partitions of decision attribute [41]. However, a RS is a formal approximation of a crisp set in terms of a pair of sets which give the lower and the upper approximation of the original set. Once the lower and upper approximation is calculated, positive, negative, and boundary regions can be derived from the approximation. Therefore, RS theory defines five regions based on the equivalent classes induced by the attribute values. Lower approximation contains all the objects, which are classified surely based on the data collected, Upper approximation contains all the objects which can be classified probably, Negative region contains the set of objects that cannot be assigned to a given class, Positive region contains the objects that can be unambiguously assigned to a given class, while the Boundary is the difference between the upper approximation and the lower approximation which contains the objects that can be ambiguously (with confidence less than 100%) assigned to a given class.

A. Elements of the rough sets

To illustrate clearly the RS technique, let's consider the main elements of RS theory. Let U be any finite universe of discourse. Let R be any equivalence relation defined on U, which partitions U. Here, (U, R) is the collection of all equivalence classes. Let $X_1, X_2 \cdots, X_n$ be the elementary sets of the approximation space (U, R). This collection is known as knowledge base. Let A be a subset of U.

Elementary sets:

$$R_A = \{X_1, X_2 \cdots, X_m\} \text{ where } X_i \text{ denote the elementary sets.} \quad (1)$$

Concepts:

$$R_{Class} = \{Y_1, Y_2 \cdots, Y_k\} \text{ where } Y_i \text{ refer to concepts.} \quad (2)$$

Lower approximation: Thus the lower approximation of a concept is the set of those elementary sets that are contained within subset of the concept with probability of 1.

$$\underline{R}_A(Y_i) = \cup X_j, \quad where\ X_j \subseteq Y_i \quad (3)$$

Upper approximation: The upper approximation of a concept is the set of those elementary sets that share some objects with the concept (non-zero probability).

$$\overline{R}_A(Y_i) = \cup X_j, \quad where X_j \cap Y_i \neq \phi \quad (4)$$

Positive region: Thus the positive region of a concept is the set of those elementary sets that are subset of the concept. Positive region would generate the strongest rule with 100% confidence.

$$POS_A(Y_i) = \underline{R}_A(Y_i) \quad (5)$$

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Boundary region: Thus the boundary region of a concept is the set of those elementary sets that have something to say about the concept, excluding the positive region. It consists of those objects that can neither be ruled in nor ruled out as members of the target set. These objects can be ambiguously (with confidence less than 100%) assigned the class denoted by Y_i. Hence, it is trivial that if $BND_A = \phi$, then A is exact. This approach provides a mathematical tool that can be used to find out all possible reducts.

$$BND_A(Y_i) = \overline{R}_A(Y_i) - \underline{R}_A(Y_i) \tag{6}$$

Negative region: Thus the negative region of a concept is the set of those elementary sets that have nothing to say about the concept. These objects cannot be assigned the class denoted by Y_i (their confidence of belonging to class Y_i is in fact 0%!)

$$NEG_A(Y_i) = U - \overline{R}_A(Y_i) \tag{7}$$

Concept Set: Concept set is the equivalence relation from the class and elementary set are equivalence relation from attributes. As mentioned above, the goal of the rough set is to understand the concept in term of elementary set. In order to map between elementary set and concept, lower and upper approximation must first defined. Then positive, boundary and negative regions can be defined based on the approximations to generate rules for categorization. Once the effect of subclass of concept is defined, the last step before rule generation is to define the net effect on entire set of concepts. Given effect of subset of concept $POS_A(Y_i)$, the net effect on entire set of concepts is defined as:

$$\begin{aligned} POS_A(Y) &= \bigcup_{i=1}^{k} POS_A(Y_i) \\ BND(Y) &= \bigcup_{i=1}^{k} BND_A(Y_i) \\ NEG_A(Y) &= \cup - \bigcup_{i=1}^{k} \overline{R}_A(Y_i) \end{aligned} \tag{8}$$

Generating rules: There are two kinds of rules that can be generated from the POS and the BND regions respectively. For any $X_i \in POS_A(Y_j)$, we can generate a 100% confidence rule of the form: If X_i then Y_j (or $X_i \Rightarrow Y_j$). For any $X_i \in BND_A(Y_i)$ we can generate a <100% confidence rule of the form: If X_i then Y_j (or $X_i \Rightarrow Y_j$), with confidence given as:

$$conf = \frac{\left|X_i \cap Y_j\right|}{X_i} \tag{9}$$

Assessment a rule: As mentioned above, the goal of the RS is to generate a set of rules that are high in dependency, discriminating index, and significance. There are three methods of assessing the importance of an attribute:

- *Dependency:* How much does a class depends on A (subset of attribute)

$$\lambda_A(class) = \frac{POS_A(class)}{\left|U\right|} \tag{10}$$

- *Discriminating Index:* Attributes A's ability to distinguish between classes

$$\beta_A(class) = \frac{\left|U - BND_A(class)\right|}{\left|U\right|} = \frac{\left|POS_A(class) \cup NEG_A(class)\right|}{\left|U\right|} \tag{11}$$

- *Significance:* How much does the data depend on the removal of A

$$\delta_A(class) = \delta_{A_1, A_2, \cdots, A_d}(class) - \delta_{A_1, A_2, \cdots, A_d - A}(class) \tag{12}$$

Significance of A is computed with regard to the entire set of attributes. If the change in the dependency after removing A is large, then A is more significant.

B. Rough Set Based Attribute Reduction

1) Literature overview

Attribute or feature selection is to identify the significant features, eliminate the irrelevant of dispensable features to the learning task, and build a good learning model. It refers to choose a subset of attributes from the set of original attributes. Attribute or feature selection of an information system is a key problem in RS theory and its applications. Using computational intelligence tools to solve such problems has recently fascinated many researchers. Computational intelligence tools are practical and robust for many real-world problems, and they are rapidly developed nowadays. Computational intelligence tools and applications have grown rapidly since its inception in the early nineties of the last century [5, 8, 16, 24]. Computational intelligence tools, which are alternatively called soft computing, were firstly limited to fuzzy logic, neural networks and evolutionary computing as well as their hybrid methods [16, 40]. Nowadays, the definition of computational intelligence tools has been extended to cover many of other machine learning tools. One of the main computational intelligence classes is Granular Computing [25, 40], which has recently been developed to cover all tools that mainly invoke computing with fuzzy and rough sets.

However, some classes of computational intelligence tools, like memory-based heuristics, have been involved in solving information systems and DM applications like other well-known computational intelligence tools of evolutionary computing and neural networks. One class of the promising computational intelligence tools is memory-based heuristics, like Tabu Search (TS), which have shown their successful performance in solving many combinatorial search problems [10, 32]. However, the contributions of memory-based heuristics to information systems and data mining applications are still limited compared with other computational

Identify applicable sponsor/s here. *(sponsors)*

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

intelligence tools like evolutionary computing and neural networks.

A decision table may have more than one reduct. Anyone of them can be used to replace the original table. Finding all the reducts from a decision table is NP-Hard [37]. Fortunately, in many real applications it is usually not necessary to find all of them and it is enough to compute one such reduct is sufficient [45]. A natural question is which reduct is the best if there exist more than one reduct. The selection depends on the optimality criterion associated with the attributes. If it is possible to assign a cost function to attributes, then the selection can be naturally based on the combined minimum cost criteria. In the absence of an attribute cost function, the only source of information to select the reduct is the contents of the data table [26, 27]. For simplicity, we adopt the criteria that the best reduct is the one with the minimal number of attributes and that if there are two or more reducts with same number of attributes, then the reduct with the least number of combinations of values of its attributes is selected. Zhong et al. have applied Rough Sets with Heuristics (RSH) and Rough Sets with Boolean Reasoning (RSBR) for attribute selection and discretization of real-valued attributes [44]. Calculation of reducts of an information system is a key problem in RS theory [20, 21, 34, 38]. We need to get reducts of an information system in order to extract rule-like knowledge from an information system. Reduct is a minimal attribute subset of the original data which has the same discernibility power as all of the attributes in the rough set framework. Obviously, reduction is an attribute subset selection process, where the selected attribute subset not only retains the representational power, but also has minimal redundancy. Many researchers have endeavored to develop efficient algorithms to compute useful reduction of information systems, see [25] for instance. Besides mutual information and discernibility matrix based attribute reduction methods, they have developed some efficient reduction algorithms based on computational intelligence tools of genetic algorithm, ant colony optimization, simulated annealing, and others [16, 20, 21]. These techniques have been successfully applied to data reduction, text classification and texture analysis [25]. Actually, the problem of attribute reduction of an information system has made great gain from rapid development of computational intelligence tools.

In the literature, much effort has been made to deal with the attribute reduction problem [6, 15, 17, 19, 20, 21, 38, 39, 43]. In their works, four computational intelligence methods, GenRSAR, AntRSAR, SimRSAR, and TSAR have been presented to solve the attribute reduction problem. GenRSAR is a genetic-algorithm-based method and its fitness function takes into account both the size of subset and its evaluated suitability. AntRSAR is an ant colony-based method in which the number of ants is set to the number of attributes, with each ant starting on a different attribute. Ants construct possible solutions until they reach a RS reduct. SimRSAR employs a simulated annealing based attribute selection mechanism. SimRSAR tries to update solutions, which are attribute subsets, by considering three attributes to be added to the current solution or to be removed from it. Optimizing the objective function attempts to maximize the RS dependency while minimizing the subset cardinality. The TSAR method proposed in [15] is based on using the Tabu Search (TS) neighborhood search methodology for searching reducts of an information system. TS is a heuristic method originally proposed by Glover in [11]. It has primarily been proposed and developed for combinatorial optimization problems [10, 12, 13], and has shown its capability of dealing with various difficult problems [10, 32]. Moreover, there have been some attempts to develop TS for continuous optimization problems [14]. TS neighborhood search is based on two main concepts; avoiding return to a recently visited solution, and accepting downhill moves to escape from local maximum information. Some search history information is reserved to help the search process to behave more intelligently. Specifically, the best reducts found so far and the frequency of choosing each attribute are saved to provide the diversification and intensification schemes with more promising solutions. TSAR invokes three diversification and intensification schemes; diverse solution generation, best reduct shaking which attempts to reduce its cardinality, and elite reducts inspiration.

The benefits of attribute reduction or feature selection are twofold: it considerably decreased the computation time of the induction algorithm and increased the accuracy of the resulting mode [41]. All feature selection algorithms fall into two categories: the filter approach and the wrapper approach. In the filter approach, the feature selection is performed as a preprocessing step to induction. The filter approach is ineffective in dealing with the feature redundancy. Some of the algorithms in the Filter approach methods are Relief, Focus, Las Vegas Filter (LVF), Selection Construction Ranking using Attribute Pattern (SCRAP), Entropy-Based Reduction (EBR), Fractal Dimension Reduction (FDR). In Relief each feature is given a relevance weighting that reflects its ability to discern between decision class labels [23]. Orlowska, in [30], conducts a breadth-first search of all feature subsets to determine the minimal set of features that can provide a consistent labeling of the training data. LVF employs an alternative generation procedure that of choosing random features subsets, accomplished by the use of a Las Vegas algorithm [26, 27]. SCRAP is an instance based filter, which determines feature relevance by performing a sequential search within the instance space [31]. Jensen et al. proposed EBR which is based on the entropy heuristic employed by machine learning techniques such as C4.5 [18]. EBR is concerned with examining a dataset and determining those attributes that provide the most gain in information. FDR is a novel approach to feature selection based on the concept of fractals – the self-similarity exhibited by data on different scales [42]. In the wrapper approach [22], the feature selection is "wrapped around" an induction algorithm, so that the bias of the operators that defined the search and that of the induction algorithm interact mutually. Though the wrapper approach suffers less from feature interaction, nonetheless, its running time would make the wrapper approach infeasible in practice, especially if there are many features, because the wrapper approach keeps running the induction algorithms on different subsets from the entire

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

attributes set until a desirable subset is identified. We intend to keep the algorithm bias as small as possible and would like to find a subset of attributes that can generate good results by applying a suite of DM algorithms. Some of the Wrapper approach methods are Las Vegas Wrapper (LVW) and neural network-based feature selection. The LVW algorithm is a wrapper method based on LVF algorithm [20, 21]. This again uses a Las Vegas style of random subset creation which guarantees that given enough time, the optimal solution will be found. Neural network-based feature selection is employed for backward elimination in the search for optimal subsets [42].

2) Mathematical modeling

The purpose of the Rough Set Attribute Reduction (RSAR) has been employed to remove redundant conditional attributes from discrete-valued datasets, while retaining their information content [37]. Attribute reduction has been studied intensively for the past one decade [20, 21, 22, 23, 28, 29]. This approach provides a mathematical tool that can be used to find out all possible reducts. However, this process is NP-hard [34], if the number of elements of the universe of discourse is large. The RSAR has as central concept the indiscernibility [41]. Let $I = (U, A)$ be an information system, where U is a non-empty set of finite objects (the universe of discourse); A is a non-empty finite set of attributes such that:

$$\text{a: } U \to V_a \tag{13}$$

$\forall\, a \in A, V_a$ being the value set of attribute a. In a decision system, $A = \{C \cup D\}$ where C is the set of conditional attributes and D is the set of decision attributes. With any $P \subseteq A$ there is an associated equivalence relation $IND(P)$:

$$IND(P) = \{(x, y) \in U^2 \,/\, \forall\, a \in P,\, a(x) = a(y)\} \tag{14}$$

If $(x, y) \in IND(P)$, then x and y are indiscernible by attributes from P. An important issue in data analysis is discovering dependencies between attributes. Intuitively, a set of attributes Q depends totally on a set of attributes P, denoted $P \Rightarrow Q$, if all attribute values from Q are uniquely determined by values of attributes from P. Dependency can be defined in the following way:

For P, $Q \subseteq A$, Q depends on P in a degree k ($0 \le k \le 1$), denoted $P \Rightarrow_k Q$, if:

$$k = \gamma_P(Q) = \frac{|POS_P(Q)|}{|U|}$$

$$where \begin{cases} \text{Q depends totally on P} & \text{if } k = 1 \\ \text{Q depends partially on P} & \text{if } 0 < k < 1 \\ \text{Q does not depend on P} & \text{if } k = 0 \end{cases}$$

By calculating the change in dependency when an attribute is removed from the set of considered conditional attributes, a measure of the significance of the attribute can be obtained. The higher the change in dependency, the more significant the attribute is. If the significance is 0, then the attribute is dispensable. More formally, given P, Q and an attribute $x \in P$, the significance of attribute x upon Q is defined by:

$$\sigma_P(Q, x) = \gamma_P(Q) - \gamma_{P-\{x\}}(Q) \tag{15}$$

The reduction of attributes is achieved by comparing equivalence relations generated by sets of attributes. Attributes are removed so that the reduced set provides the same quality of classification as the original. In the context of decision systems, a reduct is formally defined as a subset R of the conditional attribute set C such that $R(D)=C(D)$. A given dataset may have many attribute reduct sets, and the collection of all reducts is denoted by:

$$R = \{X : X \subseteq C,\, \gamma_X(D) = \gamma_C(D)\} \tag{16}$$

The intersection of all the sets in R is called the core, the elements of which are those attributes that cannot be eliminated without introducing more contradictions to the dataset. In RSAR, a reduct with minimum cardinality is searched for; in other words an attempt is made to locate a single element of the minimal reduct set $R_{\min} \subseteq R$:

$$R_{\min} = \{X : X \subseteq R, \forall\, Y \in R, |X| \le |Y|\} \tag{17}$$

The most basic solution to locating such a subset is to simply generate all possible subsets and retrieve those with a maximum RS dependency degree. Obviously, this is an expensive solution to the problem and is only practical for very simple datasets. Most of the time only one reduct is required as, typically, only one subset of features is used to reduce a dataset, so all the calculations involved in discovering the rest are pointless. Another basic way of achieving this is to calculate the dependencies of all possible subsets of C. Any subset X with $\gamma_X(D) = 1$ is a reduct; the smallest subset with this property is a minimal reduct. However, for large datasets this method is impractical and an alternative strategy is required.

An algorithm called "QuickReduct" algorithm, borrowed from [28], attempts to calculate a minimal reduct without exhaustively generating all possible subsets. It starts off with an empty set and adds in turn, one at a time, those attributes that result in the greatest increase in $\gamma_P(Q)$, until this produces its maximum possible value for the dataset (usually 1). However, it has been proved that this method does not always generate a minimal reduct, as $\gamma_P(Q)$ is not a perfect heuristic. It does result in a close to minimal reduct, though, which is still useful in greatly reducing dataset dimensionality. In order to improve the performance of the "QuickReduct" algorithm, an element of pruning can be introduced [41]. By noting the cardinality of any pre-discovered reducts, the current possible subset can be ignored if it contains more elements. However, a better approach is needed in order to avoid wasted computational effort. The pseudo code of the "Quickreduct" is given below:

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

QUICKREDUCT(C, D)

C, the set of all conditional features;
D, the set of decision features.

$R \leftarrow \{\ \}$

do

$T \leftarrow R$

$\forall\ x \in (C - R)$

if $\gamma_{R\cup\{x\}}(D) > \gamma_T(D)$ where $\gamma_R(D) = card(POS_R(D))/card(U)$

$T \leftarrow R \cup \{x\}$

$R \leftarrow T$

until $\gamma_R(D) == \gamma_C(D)$

return R

An intuitive understanding of "QuickReduct" implies that, for a dimensionality of n, n! evaluations of the dependency function may be performed for the worst-case dataset. From experimentation, the average complexity has been determined to be approximately *O(n)* [44].

III. Dynamic Rough Sets Attribute Reduction Approach

A. Solving approach by Dynamic Programming

An intelligent approach using Dynamic Programming (DP) is applied to deal with the optimization problem of RSAR where the constraints are involved in verifying the validity of developed solution. In fact, as shown in the choice of the criterion, it is to maximize the dependence degree in our solution which in principle meets all the constraints level. Using DP technique leads to generate dynamic equivalence subsets of attributes. It becomes a problem of discrete combinatorial optimization and applying DP approach leads to get an exact solution. This can be effective for the treatment of combinatorial optimization problems, in a static, dynamic or stochastic, but only if the level constraints are present in limited numbers [3]. Indeed, scaling constraints level lead to address every step of the optimization process exponentially growing number of states within the parameters sizing the problem, making it impossible to process numerically the problem of consequent dimensions. The proposed method, called Dynamic Rough Sets Attribute Reduction (DRSAR), shows promising and competitive performance compared with some other computational intelligence tools in terms of solution qualities since it produces optimistic reduct attribute subsets.

To implement an approach based on DP technique, it is necessary to define two key elements: the states and the stages and the various possible levels of constraints associated with dynamic allocation. Solving the problem of dynamic attributes reduction to build the minimal subsets of attributes by the proposed schema leads to the following mathematical formulation:

J : is the number of stages which is associated to the number of attributes;

I : is the number of states which is based on the super set of attributes;

E_j : is the number of states associated to stage j;

X_j : represents the decision vector taken at stage j;

$\sum_{j=1}^{J} p_{ij}\ x_{ij}$: represents the sum of weighted associated to a sequence of decisions $\tilde{x} = (\tilde{x}_1, \tilde{x}_2, \cdots \tilde{x}_j)$ which starts from the initial state e_0 to the current state e_j;

$TR_{ij}(e_{i,j-1}, x_{ij}) = e_{ij}$: represents the state transition ($DEP_{ij} = DEP_{i,j-1} + p_{ij}x_{ij}$) where DEP represents the dependency related to a transition.

Therefore, solving this problem involves finding an optimal sequence $\hat{x} = (\hat{x}_1, \hat{x}_2, \cdots \hat{x}_J)$ that starts from the initial state e_0 brings us to the state e_J while maximizing the following function:

$$MAX\ \left\{ \sum_{j=1}^{J} p_{ij}.x_{ij} / x_{ij} \in X_j ; e_{ij} = TR_{ij}(e_{i,j-1}, x_{ij}), \forall\ j = 1 \ldots J \right\} \quad (18)$$

The principle of optimality of dynamic programming, shows that whatever the decision in stage J brings us from state $e_{j-1} \in E_{j-1}$ to state $e_j \in E_j$, the portion of the policy between e_0 and e_{j-1} must be optimal. However, applying this principle of optimality, we can calculate step by step $AFF(J, e_J)$ using the following recurrence equation:

$$AFF(j, e_j) = \underset{\{x_{ij} \in X_j / e_{ij} = TR_{ij}(e_{i,j-1}, x_{ij})\}}{MAX} \left\{ p_{ij}.x_{ij} + AFF(j-1, e_{j-1}) \right\} \quad (19)$$

with $AFF(0, e_0) = 0$

However, if the weights p_{ij} should be such that they take into account the dependence degree reached at the tree of the solutions deployed by DP, it seems that for each state of each stage it is necessary to reassess the weights effective following the path leading to it. Thus, an exact resolution scheme by DP can be implemented directly.

B. Complexity

The algorithm based on the pattern resolution by the DP consists of three key parameters to evaluate its performance [7]. These three parameters are the number of states, the number of stages and the number of calls to the procedure that calculates the dependence weights associated with each path in the tree solutions. Let I be the number of states which is based on super set of attributes, and J is also the number of stages associated to attributes. Remember also, that a calculation of dependency weight must be made for each path in the graph. Since the solution algorithm follows the scheme of solving the DP, then it is to treat the problem as belonging to a family of similar problems and linking them through the principle of optimality.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

1) Temporal Complexity

The effectiveness of the algorithm described above is assessed by temporal complexity depending on the number of iterations needed to obtain the solution (s). The evaluation of the number of iterations is done in the worst case. Indeed, it is impossible in the general case to count the exact number of paths to build in order to solve the optimization problem. The number of paths traversed in each stage is estimated to I^2.

A set of constraints must be checked at each stage in the process of resolution, even to each path. A subset of these constraints is considered in our case. The computation time required to check all of these constraints is of the order of:

$$\sim O\left(I \times J^2\right) \tag{20}$$

Thus, the temporal complexity associated with each step in resolution (a step involves I^2 possible paths) is the order of:

$$\sim O\left(I^3 \times J^2\right) \tag{21}$$

The temporal complexity associated with treating the whole problem ("J" stages) is the order of:

$$\sim O\left(I^3 \times J^3\right) \tag{22}$$

2) Space Complexity

The memory space required for the algorithm developed here depends on the number of states and the number of stages considered. Indeed, the number of states set the maximum number of vertices to be considered in one step. This number multiplied by the number of stages defined here also helps to set the maximum number of vertices in the graph solutions. Thus, the number of variables to remember throughout the resolution process is the order of:

$$\sim O\left(I \times J\right) \tag{23}$$

IV. Case study: Implementation and Results

A. Numerical case

The proposed solution strategy has been adapted to a large retailer business. It considers the case of an international retailer having many stores with a daily average of 3000 transactions by store. We are using a large database having a large number of attributes and which cover the transactions of last 3 years. It contributes in dealing with any critical classification process. A growing RB market, where items' numbers and relationships are becoming more and more complex, is highly important since it is closely related to optimization of profit. The aim of this study is to reduce the initial number of attributes leading to reduce the complexity while preserving approximately the pattern of the predictive model. Simulations and visual analysis will be used to validate the accuracy of the improved approach. In our case, we have considered three problems that may interest the large retailer business such as: classifying the customers, classifying the items, and applying discount on item. Our algorithm simulates these real business cases by allowing the experts to define a number of attributes that describe the business case in order to be able to get the appropriate decisions. These attributes can be related to pertinent information such as: products, products category, customers, personal information, suppliers, times and seasons, price, quantity, events, and others related attributes gathered from appropriate databases. Moreover, the experts express their thoughts as added inputs to our algorithm beside the statically defined input. Therefore, data corresponding to the appropriate set of attributes are gathered and collected from a rich data warehouse oriented business based on experts' opinions. For example, experts may define some features deduced such as: the amount paid for advertising for an item over a period, the number of transactions containing an item, the percentage of transactions related to other items of the same category, the number of transactions in which an item is sold in single, etc. These new calculated attributes have distinct importance relative to the experts.

B. Performance evaluation

This section describes some characteristics of tests conducted using the DRSAR solution in order to generate dynamically the different optimal RSAR. We proceed to evaluate the performance of this new solution by analyzing the responding time and some various sensitivity features that can be conducted through the use of some metrics measure (accuracy, precision, recall). Also, we propose a comparison with some computational intelligence tools retained from the literature in order to compare the performance of the DRSAR regarding the existing ones.

The DRSAR solution method has been developed using Visual C++ on a PC computer equipped with a P-IV processor. Concerning the response time consumed by the system and which is stated in table 1, it presents a much shorter computing time than with pre-existent computational intelligence or mathematical programming methods and this response time is compatible with online use in an operations management environment. The solutions obtained by the proposed method have appeared to be significantly superior to those obtained from lengthy manual procedures or those based on some computational intelligence tools such as: genetic algorithms, simulated annealing, tabu search, ant colony, etc. Several experiments were realized in order to test and compare the classification algorithm for three cases based on a set of attributes defined by experts before and after applying DRSAR. The results are shown in the tables (2, 3, 4). For each case, it presents the number of records, the initial number of attributes, and the reduced number of attributes achieved after applying DRSAR. We report also some metrics measure (accuracy, precision, and recall) to evaluate the quality of the predictive model. We show that the number of attributes is dramatically reduced without assigning the quality of the classification. So, it is clear that our approach is efficient while its complexity is decreased by reducing the number of

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

attributes. Moreover, the metrics measures show a slight modification while the optimal subsets are dealt with instead of considering the whole attributes defined by the experts.

In order to achieve the performance evaluation of the DRSAR, we compare it with the some intelligence computational tools developed in the literature and which dealt with the reduction of attribute sets in RS such as: Ant Colony optimization for Rough Set Attribute Reduction (AntRSAR) [19, 20, 21]; Simulated Annealing for Rough Set Attribute Reduction (SimRSAR) [19]; Genetic Algorithm for Rough Set Attribute Reduction (GenRSAR) [19, 20, 21]; and Tabu Search Attribute Reduction (TSAR) [15]. The results of this comparison are reported in Table 5 and figures (1, 2). The results in Table 5 focus on the reduced number of attributes achieved by each method after several runs and the corresponding dependency (Dep.) degree function.

The results shown in the above table show that the DRSAR approach is the best since it is based on an optimistic method while the others are of type greedy heuristics. DRSAR outperforms all the considered methods TSAR, AntRSAR, GenRSAR, and SimRSAR for any datasets (Figure 1). The performance of TSAR and AntRSAR is comparable since there is no significant difference between them for any datasets. We note here that TSAR outperforms AntRSAR for dataset 2, while it is not the case for dataset 1. TSAR and AntRSAR outperform GenRSAR and SimRSAR methods for all tested datasets. SimRSAR outperforms GenRSAR for any dataset except the dataset 2. Concerning the dependency function degree, we note here that the degree of dependency associated to the reduced number of attributes is optimal while using DRSAR. AntRSAR and TSAR are more performance than GenRSAR and SimRSAR (Figure 2).

We conclude that the proposed method, shows promising and competitive performance compared with others computational intelligence tools in terms of solution qualities. Moreover, DRSAR shows a superior performance in saving the computational costs.

TABLE I. COMPARING THE RELATED FEATURES BY USING DRSAR

Cases	*Initial number of concept attributes*	*Minimum Reduced attributes*	*Computing time (sec.)*
A-Customers classification	*28*	*19*	*1.65*
B-Items classification	*52*	*41*	*8.81*
C-Applying discount on item	*83*	*68*	*32.35*

TABLE II. CONFUSION MATRIX RESULTS FOR CUSTOMERS CLASSIFICATION BEFORE/AFTER DRSAR

# records: *417.200*	***# Initial set of attributes***	*28*	***# of attributes in the reduced DRSAR***	*19*

Count		***Predicted class***	
		Solvent	*Insolvent*
Actual class	*Solvent*	*319535*	*7705*
	Insolvent	*8650*	*81310*

Count		***Predicted class***	
		Solvent	*Insolvent*
Actual class	*Solvent*	*318675 (99.73%)*	*8920 (86.38%)*
	Insolvent	*7595 (88.19%)*	*82010 (99.75%)*

Accuracy	*96.03*	***Error rate***	*0.92%*
Precision	*97.75*	***Recall***	*97.17*

TABLE III. CONFUSION MATRIX RESULTS FOR ITEMS CLASSIFICATION BEFORE/AFTER DRSAR

# records: *933.820*	***# Initial set of attributes***	*52*	***# of attributes in the reduced DRSAR***	*41*

Count		***Predicted class***	
		Attractive	*Non-Attractive*
Actual class	*Attractive*	*822430*	*3145*
	Non-Attractive	*6725*	*101520*

Count		***Predicted class***	
		Attractive	*Non-Attractive*
Actual class	*Attractive*	*822217 (99.74%)*	*3133 (99.62%)*
	Non-Attractive	*8740 (77.05%)*	*99730 (98.73%)*

Accuracy	*98.72*	***Error rate***	*0.43%*
Precision	*98.95*	***Recall***	*99.62*

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

TABLE IV. CONFUSION MATRIX RESULTS FOR APPLYING DISCOUNT ON ITEM BEFORE/AFTER DRSAR

# records:	*933.820*	***# Initial set of attributes***	*83*	***# of attributes in the reduced DRSAR***	*68*

Count		***Predicted class***	
		Yes	*No*
Actual class	*Yes*	*12746*	*170*
	No	*98*	*2986*

Count		***Predicted class***	
		Yes	*No*
Actual class	*Yes*	*12739 (99.94%)*	*166 (97.65%)*
	No	*127 (77.16%)*	*2968 (99.74%)*

Accuracy	*98.16*	***Error rate***	*0.36%*
Precision	*99.01*	***Recall***	*98.71*

TABLE V. REPORTED RESULTS BASED ON THE NUMBER OF ATTRIBUTES AND DEPENDENCY DEGREE FUNCTION

# records	**# Initial Sets of attributes**	**DRSAR**		**GenRSAR**		**AntRSAR**		**TSAR**		**SimRSAR**	
		# attr.	**Dep.**	**# attr.**	**Dep.**	**# attr.**	**Dep.**	**# attr.**	**Dep.**	**# attr.**	**Dep.**
417.200	*28*	*19*	*1*	*24*	*0.68*	*21*	*0.78*	*22*	*0.77*	*23*	*0.69*
933.820	*52*	*41*	*1*	*45*	*0.64*	*43*	*0.72*	*43*	*0.74*	*47*	*0.66*
933.820	*83*	*68*	*1*	*78*	*0.59*	*73*	*0.64*	*72*	*0.69*	*74*	*0.61*

Figure 1. Comparison of methods in RSAR based on the # of attributes

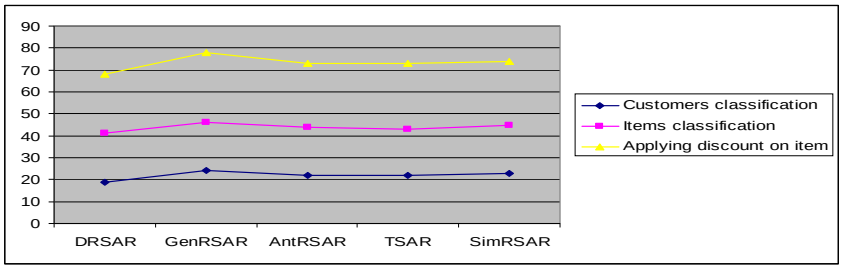
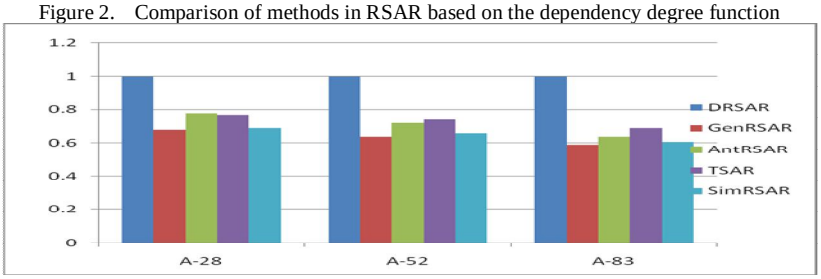


Figure 2. Comparison of methods in RSAR based on the dependency degree function



V. CONCLUSION AND PERSPECTIVES

In this communication, a new solution approach is proposed in order to reduce the complexity of the classification problems faced by Retailer business. Moving on from traditional heuristic methods, an optimal one based on Dynamic Programming, called DRSAR, is proposed. The proposed approach produces an exact solution in mathematical terms and appears to be quite adapted, if necessary, to the operational context of the retailer business and provides, through a comprehensive process for the decision-makers, improved legible solutions. This technique provides a dynamic solution that can be executed on any classification problems without taking into consideration the classification techniques that will be used later. It permits to explore the optimal sets of significant attributes that can drive the profit of the company and reduced the process complexity. Numerical experiments on three classification problem cases have been considered and performed in order to validate the proposed solution approach for retailer business. It had been tested on a real database with 3 years historical data. The obtained results had been found plausible. Comparisons with other computational intelligence tools have revealed that DRSAR is promising and it is less expensive in computing the dependency degree function.

In perspectives, a Decision Support System should integrate many other aspects that may be highly relevant such as:

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Customer Retention, Buyer Behavior, Cost/Utilization, Halo and Cannibalization, Detect positive and negative correlation among items, Quality Control, Inventory, etc. This is performed in order to improve the efficiency of business retailer operations.

REFERENCES

[1] T. Bhavani, K. Latifur, A. Mamoun, and W. Lei, "Design and Implementation of data mining tools. Data Mining Techniques and Applications", Web Data Management and Mining, 2009.

[2] C. Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley & Sons, 2009, ISBN: 978-0-470-51138-1.

[3] R.E. Bellman, "Dynamic Programming", Princeton University Press, 1957.

[4] G. Linoff and M. Berry, "Data mining techniques for marketing, sales and customer relationship management", 3rd Ed., Wiley & Sons, 2004.

[5] E.K. Burke and G. Kendall, "Search Methodlogies: Introductory Tutorials in Optimization and Decision Support Techniques", Springer-Verlag, Berlin, 2005.

[6] A. Chouchoulas and Q. Shen, "Rough set-aided keyword reduction for text categorisation", Applied Artificial Intelligence, 2001. Vol. 15, pp. 843–873.

[7] W. Moudani and F. Mora-Camino, "A Dynamic Approach for Aircraft Assignment and Maintenance Scheduling by Airlines", Journal of Air Transport Managment, 2000, Vol. 4 (1), pp. 233-237.

[8] A.P. Engelbrecht, "Computational Intelligence: An Introduction", John Wiley & Sons, Chichester, England, 2003.

[9] K.J. Ezawa and S.W. Norton, "Constructing Bayesian networks to predict uncollectible telecommunications accounts", IEEE Intelligent Systems, 1996, Vol. 11 (5), pp. 45-51.

[10] F. Glover and M. Laguna, "Tabu Search", Kluwer Academic Publishers, Boston, MA, USA, 1997.

[11] F. Glover, "Future paths for integer programming and links to artificial intelligence", Computers and Operations Research, 1986, Vol. 13, pp. 533–549.

[12] F. Glover, "Tabu search–Part I", ORSA Journal on Computing, 1989, Vol. 1, pp.190–206.

[13] F. Glover, "Tabu search–Part II", ORSA Journal on Computing, 1990, Vol. 2, pp. 4–32.

[14] A. Hedar and M. Fukushima, "Tabu search directed by direct search methods for nonlinear global optimization", European Journal of Operational Research, 2006, Vol. 170, pp. 329–349.

[15] A. Hedar, J. Wangy, and M. Fukushima, "Tabu search for attribute reduction in rough set theory", Journal of Soft Computing - A Fusion of Foundations, Methodologies and Applications, Springer-Verlag Berlin, Heidelberg, 2008, Vol. 12 (9).

[16] W. Moudani and F. Mora-Camino, "Management of Bus Driver Duties using data mining," International Journal of Applied Metaheuristic Computing (IJAMC), 2011, Vol 2 (2)

[17] J. Jelonek, K. Krawiec, and R. Slowinski, "Rough set reduction of attributes and their domains for neural networks", Computational Intelligence, 1995, Vol. 11, pp. 339–347.

[18] R. Jensen and Q. Shen, "A Rough Set – Aided system for Sorting WWW Bookmarks", Web Intelligence: Research and Development, 2001, pp. 95-105.

[19] R. Jensen and Q. Shen, "Finding rough set reducts with ant colony optimization". Proceedings of the 2003 UK Workshop on Computational Intelligence, 2003, pp. 15–22.

[20] R. Jensen and Q. Shen, "Fuzzy-rough attribute reduction with application to web categorization", Fuzzy Sets and Systems, 2004, Vol. 141 (3), pp. 469-485.

[21] R. Jensen and Q. Shen, "Semantics-preserving dimensionality reduction: Rough and fuzzy rough-based approaches", IEEE Transactions on Knowledge and Data Engineering, 2004, Vol. 16, pp.1457–1471.

[22] G.H. John, R. Kohavi, and K. Pfleger, "Irrelevant Features and the Subset Selection Problem". Proceedings of 11th Intl. Conf. on Machine Learning, 1994, pp.121-129.

[23] K. Kira and L.A. Rendell, "The Feature selection Problem: Traditional Methods and a New Algorithm". Proceedings of AAAI, MIT Press, 1992, pp. 129-134.

[24] A. Konar, "Computational Intelligence: Principles, Techniques and Applications", Springer-Verlag, Berlin, 2005.

[25] T.Y. Lin, Y.Y. Yao, and L.A. Zadeh, "Data Mining, Rough Sets and Granular Computing", Springer-Verlag, Berlin, 2002.

[26] H. Liu and R. Setiono, "A probabilistic approach to feature selection: a filter solution". Proceedings of the 9th International conference on Industrial and Eng. Applications of AI and ES, 1996, pp. 284-292.

[27] H. Liu and R. Setiono, "Feature selection and classification–A probabilistic wrapper approach", Proceedings of the 9th Intl. Conf. on Indust. and Eng. Applications of AI and ES, 1996, pp. 419-424.

[28] H. Liu and H. Motoda, "Feature Extraction Construction and Selection: A Data mining Perspective", Kluwer International Series in Engineering and Computer Science, Kluwer Academic Publishers, 1998.

[29] M. Modrzejewski, M., "Feature Selection Using Rough Sets Theory", Proceedings of the 11th International Conference on Machine Learning, 1993, pp. 213-226.

[30] E. Orlowska, "Incomplete Information: Rough Set Analysis", Physica-Verlag, Heidelberg, 1998.

[31] B. Raman and T.R. Loerger, "Instance-based filter for feature selection", Journal of Machine Learning Research, 2002, pp. l1-23.

[32] C. Rego and B. Alidaee, "Metaheursitic Optimization via Memory and Evolution", Springer-Verlag, Berlin, 2005.

[33] Z. Pawlak, "Rough Sets", Intl. Journal of Computer and Information Sciences, 1982, Vol. 11(5), pp.341- 356.

[34] Z. Pawlak, "Rough Sets: Theoretical aspects of reasoning data", Kluwer Academic Publishers, 1991.

[35] J.F. Peters and A. Skowron, "Transactions on Rough Sets 1", Springer-Verlag, Berlin, 2004.

[36] D. Pyle, "Business Modeling and Data Mining", Morgan Kaufmann Publishers, 2003.

[37] Q. Shen and A. Chouchoulas, "A modular approach to generating fuzzy rules with reduced attributes for the monitoring of complex systems", Eng. Applications of Artificial Intelligence, 2000, Vol. 13(3), pp. 263-278.

[38] R.W. Swiniarski and A. Skowron, "Rough set methods in feature selection and recognition", Pattern Recognition Letters, 2003, Vol. 24, pp. 833–849.

[39] S. Tan, "A global search algorithm for attributes reduction", Advances in Artificial Intelligence, G.I. Webb and X. Yu (eds.), LNAI 3339, 2004, pp. 1004–1010.

[40] Tettamanzi, A., Tomassini, M., and Janben, J. (2001) Soft Computing: Integrating Evolutionary, Neural, and Fuzzy Systems. Springer-Verlag, Berlin

[41] K. Thangavel, Q. Shen, and A. Pethalakshmi, "Application of Clustering for Feature selection based on rough set theory approach", AIML Journal, 2006, Vol. 6 (1), pp.19-27.

[42] C. Traina, L. Wu, and C. Faloutsos, "Fast Feature selection using the fractal dimension", Proceeding of the 15th Brazilian Symposium on Databases (SBBD), 2000.

[43] L.Y. Zhai, L.P. Khoo, and S.C. Fok, "Feature extraction using rough set theory and genetic algorithms– an application for simplification of product quality evaluation", Computers & Industrial Engineering, 2002, Vol. 43, pp. 661–676.

[44] N. Zhong and A. Skowron, "A Rough Set-Based Knowledge Discovery Process", Intl. Journal of App. Mathematics and Computer Sciences, 2001, Vol. 11 (3), pp.603-619.

[45] X. Hu, T.Y. Lin, and J. Jianchao, "A New Computation Model for Rough Sets Based on Database Systems", Lecture Notes in Computer Science,Vol. 2737/2003, pp. 381-390, 2003.

A Study on the Performance of Classical Clustering Algorithms with Uncertain Moving Object Data Sets

Angeline Christobel . Y
College of Computer Studies
AMA International University
Salmabad, Kingdom of Bahrain
angeline_christobel@yahoo.com

Dr. Sivaprakasam
Department of Computer Science
Sri Vasavi College
Erode, India
psperode@yahoo.com

Abstract— **In recent years, real world application domains are generating data with uncertainty, incomplete and probabilistic in nature. Examples of such data include location based services, sensor networks, scientific and biological databases. Data mining is widely used to extract interesting patterns in the large amount of data generated by such applications.**

In this paper, we addressed the classical mining and data-analysis algorithms, particularly clustering algorithms, for clustering uncertain and probabilistic data. To model uncertain database, we simulated a moving object database with two states: one contains real location and another contains outdated recorded location. We evaluated the performance and compared the results of clustering the two states of location data with k-means, DBSCAN and SOM.

Key Words: ***Data Mining, Uncertain Data, Moving Objects Database, Clustering.***

I. INTRODUCTION

Data uncertainty naturally arises in many real world applications due to reasons such as outdated sources or imprecise measurement. This is true for applications such as location based services [12] and sensor monitoring [6] that needs interaction with the physical world. For example, in the case of moving objects, it is impossible for the database to track the exact locations of all objects at all time. So the location of each object is associated with uncertainty between updates [7]. In order to produce good mining results, their uncertainties have to be considered.

In recent years, there has been much research on the management of uncertain data in databases, such as the representation of uncertainty in databases and querying data with uncertainty but only little research work has addressed the issue of mining uncertain data. Many scientific methods for data collection are known to have error-estimation methodologies built into the data collection and feature extraction process. In[2],[13], a number of real applications, in which such error information can be known or estimated a-priori has been summarized as follows:

- The statistical error of data collection can be estimated by prior experimentation, if the inaccuracy arises out of the limitations of data collection equipment. In such cases, different features of observation may be collected to a different level of approximation.
- The imputation procedures can be used to estimate the missing values in the case of missing data. The statistical error of imputation for a given entry is often known a-priori, if such procedures are used.
- Data mining methods are applied to derived data sets that are generated by statistical methods such as forecasting. In such cases, the error of the data can be derived from the methodology used to construct the data.
- The data is available only on a partially aggregated basis in many applications such as demographic data sets. Each aggregated record is actually a probability distribution.
- The trajectory of the objects may be unknown in many mobile applications. In fact, many spatiotemporal applications are inherently uncertain, since the future behavior of the data can be predicted only approximately.

This paper will neither address the existing techniques for uncertain data clustering nor propose a new one. Instead, it will address the impact of uncertain data in clustering results using a primitive model of a moving object database.

II. CLUSTERING ALGORITHMS

Clustering is a data mining technique used to identify clusters based on the similarity between data objects. Traditionally, clustering is applied to unclassified data objects with the objective to maximize the distance between clusters and minimize the distance inside each cluster. Clustering is widely used in many applications including pattern recognition, dense region identification, customer purchase pattern analysis, web pages grouping, information retrieval, and scientific and engineering analysis. Clustering algorithms deal with a set of objects whose positions are accurately known [3].

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

To study the performance of the clustering algorithms with uncertain moving object date sets, we have chosen K-means, DBSCAN, SOM algorithms and it is discussed below.

A) K-Mean Clustering algorithm

One of the best known and most popular clustering algorithms is the k-means algorithm. K-means clustering involves search and optimization.

K-means is a partition based clustering algorithm. K-means' goal is to partition data D into K parts, where there is little similarity across groups, but great similarity within a group. More specifically, K-means aims to minimize the mean square error of each point in a cluster, with respect to its cluster centroid.

Formula for Square Error:

$$\text{Square Error (SE)} = \sum_{i=1}^{k} \sum_{j=1}^{|ci|} \left(x_j - M_{ci} \right),$$

where k is the number of clusters, |ci| is the number of elements in cluster ci, and M_{ci} is the mean for cluster ci.

Steps of K-Means Algorithm

The k Means algorithm is explained in the following steps. The algorithm normally converges in short iterations. But will take considerably long time for iteration if the number of data points and the dimension of each data are high.

Step 1: Choose k random points as the cluster centroids.

Step 2: For every point p in the data, assign it to the closest centroid. That is compute d(p, M_{ci}) for all clusters, and assign p to cluster C* where distance

(d(P, M_{c*}) <= d(P, M_{ci}))

Step 3: Recompute the center point of each cluster based on all points assigned to the said cluster.

Step 4: Repeat steps 2 & 3 until there is convergence. (Note: Convergence can mean repeating for a fixed number of times, or until SE_{new} - SE_{old} <= ε, where ε is some small constant, the meaning being that we stop the clustering if the new SE objective is sufficiently close to the old SE.)

B) DBSCAN Algorithm

Density based spatial clustering of applications with noise rely on a density-based notion of clusters, which is designed to discover clusters of arbitrary shape and also have ability to handle noise.

DBSCAN requires two parameters

- Eps: Maximum radius of the neighborhood
- MinPts: Minimum number of points in an Eps-neighborhood .

The clustering process is based on the classification of the points in the dataset as core points, border points and noise points and on the use of density relations between points directly density reachable, density reachable, density connected[Ester 1996] to form the clusters.

Core points:
The points that are at the interior of a cluster are called core points. A point is an interior point if there are enough points in its neighborhood.

Border points:
Points on the border of a cluster are called border points.
NEps(p): {q belongs to D | dist(p,q) <= Eps}

Noise points:
A noise point is any point that not a core point or a border point.

Directly Density-Reachable:
A point *p* is directly density-reachable from a point *q* with respect to *Eps*, *MinPts* if *p* belongs to *NEps(q)* *|NEps (q)| >= MinPts*

Density-Reachable:
A point *p* is density-reachable from a point *q* with respect to *Eps*, *MinPts* if there is a chain of points *p1*, …, *pn*, *p1 = q*, *pn = p* such that *pi+1* is directly density-reachable from *pi*

Density-Connected:
A point *p* is density-connected to a point *q* with respect to *Eps*, *MinPts* if there is a point *o* such that both, *p* and *q* are density-reachable from *o* with respect to *Eps* and *MinPts*.

Algorithm: The algorithm of DBSCAN is as follows (M. Ester, H. P. Kriegel, J. Sander, 1996)

- Arbitrary select a point *p*
- Retrieve all points density-reachable from *p* with respect to *Eps* and *MinPts*.
- If *p* is a core point, a cluster is formed.
- If *p* is a border point, no points are density-reachable from *p* and DBSCAN visits the next point of the database.
- Continue the process until all of the points have been processed.

C) The Self-Organizing Map SOM

The Self Organizing Map (SOM) is developed by Professor Teuvo Kohonen in the early 1980's. It is a computational method for the visualization and analysis of high dimensional data.

A self organizing map consists of components called nodes. The nodes of the network are connected to each other, so that it becomes possible to determine the neighborhood of a node. Each node receives all elements of the training set, one at a time, in vector format. For each element, Euclidean distance is calculated to determine the fit between that element and the

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

weight of the node. The weight is a vector of the same dimension as the input vectors. This allows to determine the "winning node", that is the node that represents the best training element. Once the winning node is found, the neighbors of the winning node are identified. The winning node and these neighbors are then updated to reflect the new training element.

It appears to be customary that both the neighborhood function and the learning rate are a decreasing function of time. This means that as more training elements are learned, the neighborhood is smaller and the nodes are less affected by the new elements.

We express this change as the following function: for a node x, the update is equal to

$x(t+1) = x(t) + N(x,t)\alpha(t)(\xi(t) - x(t))$

Where

x(t+1) is the next value of the weight vector

x(t) is the current value of the weight vector

N(x,t) is the neighborhood function, which decreases the size of the neighbourhood as a function of time

α(t) is the learning rate, which decreases as a function of time

ξ(t) is the vector representing the input document

Based on this information, the algorithm is given below.

Algorithm

1. Initialize the weights of the nodes, either to random or pre computed values
2. For all input elements:
   - Take the input, get its vector
   - For each node in the map: Compare the node with the input's vector
   - The node with the vector closest to the input vector is the winning node.
   - For the winning node and its neighbors, update them according to the formula above.

The Metric Used to Measure the Performance

In order to compare clustering results against external criteria, a measure of agreement is needed. Since we assume that each record is assigned to only one class in the external criterion and to only one cluster, measures of agreement between two partitions can be used.

The Rand index or Rand measure is a commonly used technique for measure of such similarity between two data clusters. This measure was found by W. M. Rand and explained in his paper "Objective criteria for the evaluation of clustering methods" in Journal of the American Statistical Association (1971).

Given a set of n objects S = {O1, ..., On} and two data clusters of S which we want to compare: X = {x1, ..., xR} and Y = {y1, ..., yS} where the different partitions of X and Y are disjoint and their union is equal to S; we can compute the following values:

a is the number of elements in S that are in the same partition in X and in the same partition in Y,

b is the number of elements in S that are not in the same partition in X and not in the same partition in Y,

c is the number of elements in S that are in the same partition in X and not in the same partition in Y,

d is the number of elements in S that are not in the same partition in X but are in the same partition in Y.

Intuitively, one can think of a + b as the number of agreements between X and Y and c + d the number of disagreements between X and Y. The Rand index, R, then becomes,

$$R = \frac{a+b}{a+b+c+d} = \frac{a+b}{\binom{n}{2}}$$

The Rand index has a value between 0 and 1 with 0 indicating that the two data clusters do not agree on any pair of points and 1 indicating that the data clusters are exactly the same.

III. MODELING MOVING OBJECT DATABASE WITH UNCERTAINTY

The following figure from [1] illustrates the problem when a clustering algorithm is applied to moving objects with location uncertainty. Figure 4(a) shows the actual locations of a set of objects, Figure 4(b) shows the recorded location of these objects, which are already outdated and Figure4(c) shows the uncertain data locations. The clusters obtained from these outdated values could be significantly different from those obtained as if the actual locations were available (Figure 4(b)). If we solely rely on the recorded values, many objects could possibly be put into wrong clusters. Even worse, each member of a cluster would change the cluster centroids, thus resulting in more errors.

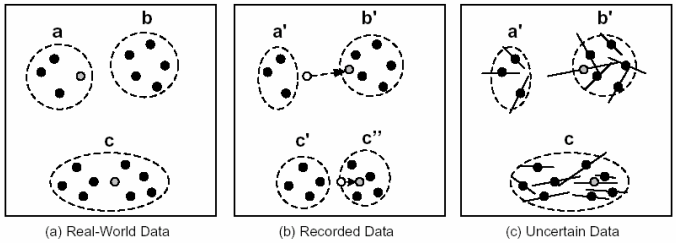


Figure 4: The Uncertain Data Clustering Scenario

We have modeled a moving object database to resemble the previously explained scenario. Here we present an example case of the model under consideration. The Attributes of the Simulated Moving Object Database presented here are:

The Number of Groups	: 5
The Number of Dimensions	: 2
Number of Objects per Groups	: 50
The Standard Deviation	: 0.6

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Total Area : 2000 Sq. Units

Max Possible Mobility in unit time : 200 Units

Total Number of Locations : 250

Percentage of Uncertain Locations : 10 % (25 locations)

The following plot of locations represents the real location of the object at time t.

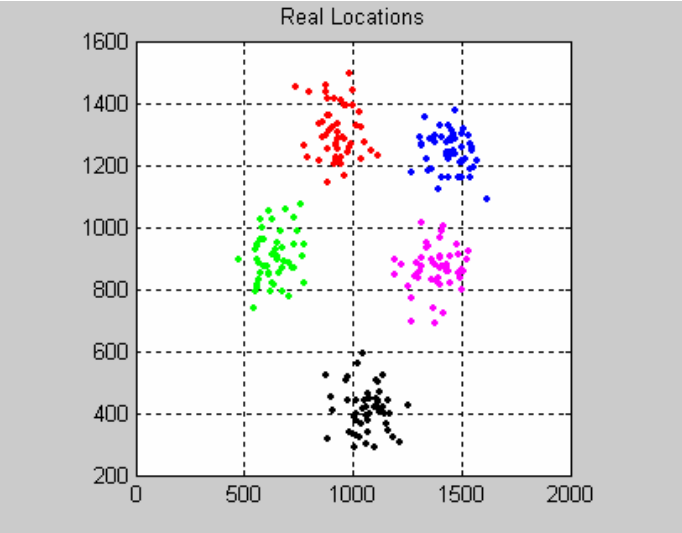


Figure 5: Real Object Locations at Time t

The following plot of locations represents the recorded location of the object at the same time t.

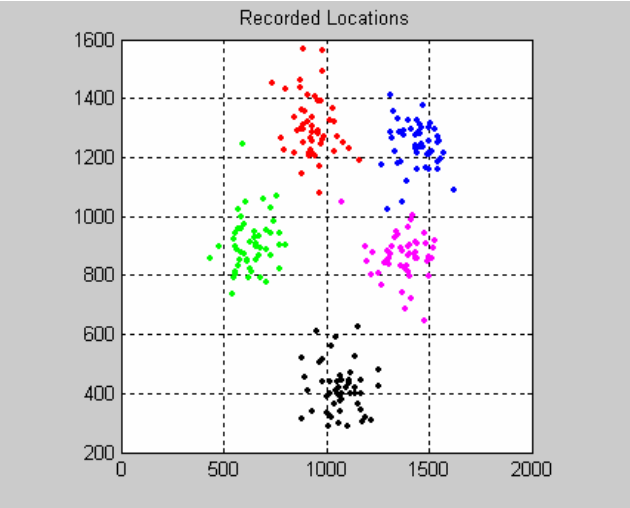


Figure 6: Recorded Object Locations at Time t

Since there are approximately 10% of un-updated objects in the database (intentionally introduced to simulate uncertainty), this plot is slightly different from the previous one. Due to the uncertainty in the data, if we apply any classical clustering algorithm, then certainly cluster centers in the two case will slightly different from one another.

IV. EXPERIMENTAL RESULTS

We have implemented the three clustering algorithms K-means, DBSCAN and SOM in Matlab and performed the experiments on a normal desktop computer.

We have kept some parameters of the simulation as constant and vary few parameters and measured the performance. The following are the Constant and variable parameters of the simulation:

The Number Of Groups/Clusters : 3,4,5,6,7
The Number Of Dimensions : 2
Number Of Objects Per Groups : 50
The Standard Deviation : 0.4-0.6
Total Area :2000 Sq. Units
Max Possible Mobility in unit time :200 Units
Total Number of Locations : 250
Percentage of Uncertain Locations :10 % (25 locations)

The Number of Groups/Clusters was changed and in each case the Rand index was measured with real data as well as the recorded data with uncertainty. During creating synthetic moving object database, the parameter, the standard deviation is only used to attain non overlapping and well distributed clusters. To simulate uncertainty, 10% of locations (uncertainty) were randomly altered from 0 to 200 units of distance.

In the following table(Table 1), we summarized the results arrived in several iterations.

Table 1: Summary of results

Sl No	Number of Clusters	Accuracy of Classification (Rand Index)					
		With Real Data			With Recorded Uncertain Data		
		k-mean	SOM	DBSCAN	k-mean	SOM	DBSCAN
1	3	0.94	1.00	0.99	0.86	0.96	0.93
2	4	0.89	0.99	0.98	0.84	1.00	0.97
3	5	0.84	0.92	0.92	0.88	0.99	0.83
4	6	0.83	0.99	0.94	0.79	0.93	0.75
5	7	0.79	0.99	0.82	0.83	0.97	0.76
	Avg	0.86	0.98	0.93	0.84	0.97	0.85

The following graph (Figure 7) shows the accuracy of classification of real data. The Rand Index was measured between the original and calculated class labels of real data.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

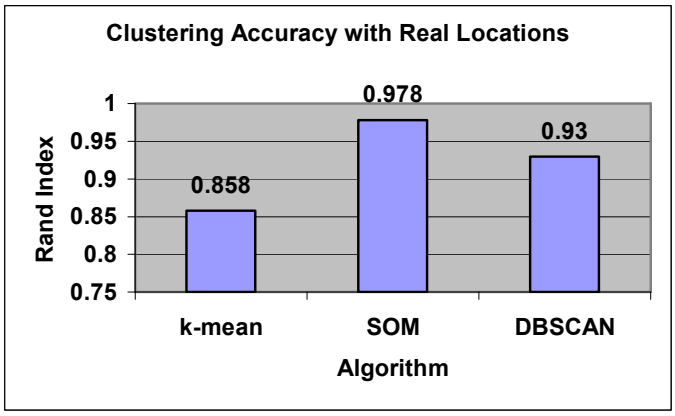


Figure 7: Accuracy of clustering with real locations

The following graph (Figure 8) shows the accuracy of classification of Recorded data. The Rand Index was measured between the original and calculated class labels of recorded data.

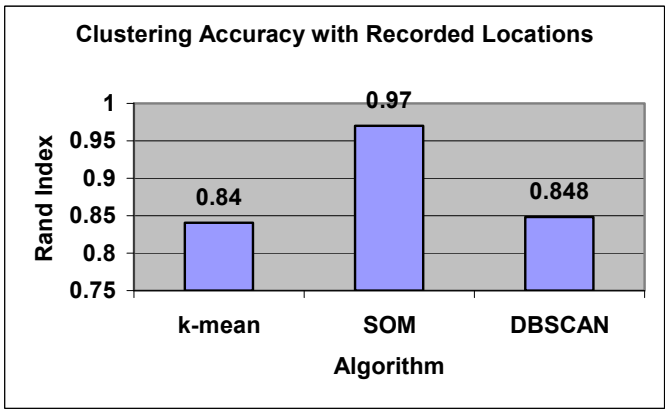


Figure 8: Accuracy of Clustering with Recorded Locations

The following graph (Figure 9) shows the difference in accuracy of classification between Real and Recorded data.

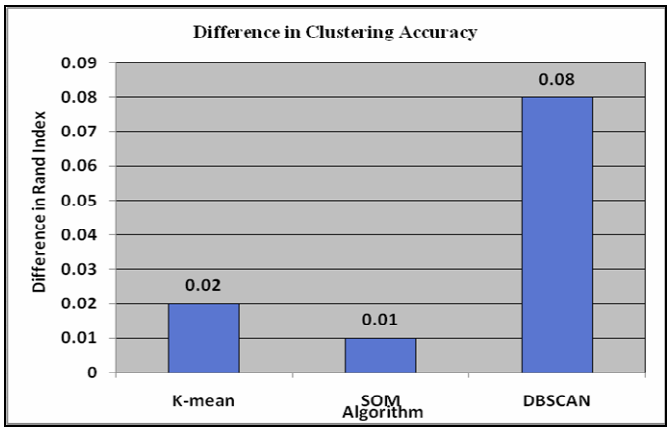


Figure 9: The difference in clustering accuracy

V. Conclusion and Scope for Further Enhancements

Traditional clustering algorithms do not consider uncertainty inherent in a data item and can produce incorrect mining results that do not correspond to the real-world data. All the three algorithms produced little bit poor result with uncertain data. But, while comparing the results with one another, it was observed that, the SOM based clustering algorithm has some ability to produce meaningful results even with the presence of uncertain records in the data. The reason for better results in the case of SOM may be the aspect of unsupervised training involved in the clustering process which is approximating the uncertain data in a meaningful way.

DBSCAN clustering algorithm and K-mean clustering algorithm were produced comparatively poor results than SOM. Particularly, the density based clustering algorithm DBSCAN produced little bit poor result than k-means. The main reason for this poor result is the nature of distribution of data (sphere/spheroid shaped distribution) under consideration. Generally all the density based clustering algorithms will try to do clustering in spatial data sets with clusters of widely varying shapes; varying densities; and very large data sets. With such kind of data, we may expect good results with DBSCAN

Future works may address the methods for handling the uncertainty along with other attributed during the clustering process. In fact, there are few already available solutions for uncertain data clustering with modified or improved k-means algorithm and DBSCAN algorithm. One may address new ideas to improve the existing algorithms. Further, the issues involved in improving the performance of the algorithm in terms of speed as well as accuracy may be addressed in future works.

VI. References

1. Chau, M., Cheng, R., and Kao, B., "Uncertain Data Mining: A New Research Direction," in Proceedings of the Workshop on the Sciences of the Artificial, Hualien, Taiwan, 2005.
2. Charu C. Aggarwal, "On Density Based Transforms for Uncertain Data Mining", IBM T. J. Watson Research Center, 19 Skyline Drive, Hawthorne, NY
3. Ben Kao Sau, Dan Lee, David W. Cheung, Wai-Shing Ho, K. F. Chan, "Clustering Uncertain Data using Voronoi Diagrams", Eighth IEEE International Conference on Data Mining,2008
4. Barbara, D., Garcia-Molina, H. and Porter, D. "The Management of Probabilistic Data," IEEE Transactions on Knowledge and Data Engineering, 1992.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

5. Bezdek, J. C. Pattern Recognition with Fuzzy Objective Function Algorithms. Plenum Press, New York (1981).
6. Cheng, R., Kalashnikov, D., and Prabhakar, S. "Evaluating Probabilistic Queries over Imprecise Data," Proceedings of the ACM SIGMOD International Conference on Management of Data, June 2003.
7. Cheng, R., Kalashnikov, D., and Prabhakar, S. "Querying Imprecise Data in Moving Object Environments," IEEE Transactions on Knowledge and Data Engineering, 2004
8. Cheng, R., Xia, X., Prabhakar, S., Shah, R. and Vitter, J. "Efficient Indexing Methods for Probabilistic Threshold Queries over Uncertain Data," Proceedings of VLDB, 2004.
9. Hamdan, H. and Govaert, G. "Mixture Model Clustering of Uncertain Data," IEEE International Conference on Fuzzy Systems, 2005.
10. Ruspini, E. H. "A New Approach to Clustering," Information Control, 1969.
11. Sato, M., Sato, Y., and Jain, L. "Fuzzy Clustering Models and Applications", Physica-Verlag, Heidelberg 1997.
12. Wolfson, O., Sistla, P., Chamberlain, S. and Yesha, Y. "Updating and Querying Databases that Track Mobile Units," Distributed and Parallel Databases, 1999.
13. Charu C. Aggarwal and Philip S. Yu "A Survey of Uncertain Data Algorithms and Applications" IEEE transactions on knowledge and data Engineering, 2009
14. Martin Ester, Hans Peter Kriegel, Jorg Sander, Xiaowei Xu " A Density based Algorithm for Discovering Clusters in Large Spatial Databases with Noise" Proceedings of 2nd International Conference on Knowledge Discovery and Data mining(KDD-96)
15. H.P.Kriegel and M.Pfeifle, "Density based clustering of uncertain data:, ACM KDD Conference,2005
16. Charu C. Aggarwal and Philip S. Yu "On Indexing High Dimensional Data With Uncertainty", IBM T. J. Watson Research Center
17. Rustum R, Adeloye AJ. "Replacing outliers and missing values from activated sludge data using Kohonen Self Organizing Map". *Journal of Environmental Engineering*,2007

AUTHOR'S PROFILE

Ms.Angeline Christobel, Asst. Professor, AMA International University, Bahrain is currently pursuing her research in Karpagam University, Coimbatore, Tamil Nadu, India. Her research interest is in Data mining.

Dr. Sivaprakasam is working as a Professor in Sri Vasavi College, Erode, Tamil Nadu, India. His research interests include Data mining, Internet Technology, Web & Caching Technology, Communication Networks and Protocols, Content Distributing Networks.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Bijection and Isomorphism on Graph of $S_n(123,132)$ from One of (n-1) Length Binary Strings

A. Juarna[1], A.B. Mutiara[2]
Faculty of Computer Science and Information Technology, Gunadarma University
Jl. Margonda Raya No.100, Depok 16424, Indonesia
[1,2]{ajuarna,amutiara}@staff.gunadarma.ac.id

***Abstract*—Simion and Schmidt showed in 1985 that the cardinality of the set $S_n(123,132)$ length n permutations avoiding the patterns 123 and 132, is 2^{n-1}, but in the other side 2^{n-1} is the cardinality of the set $B_{n-1} = \{0,1\}^{n-1}$ of length (n-1) binary strings. Theoretically, it must exist a bijection between $S_n(123,132)$ and B_{n-1}. In this paper we give a constructive bijection between B_{n-1} and $S_n(123,132)$; we show that it is actually an isomorphism and illustrate this by constructing a Gray code for $S_n(123,132)$ from a known similar result for B_{n-1}. As we noted that an isomorphism between two combinatorial classes is a closeness preserving bijection between those classes, that is, two objects in a class are closed if and only if their images by this bijection are also closed. Often, as in this paper, closeness is expressed in terms of Hamming distance. Isomorphism allows us to find out some properties of a combinatorial class X (or for the graph induced by the class X) if those properties are found in the pre image of the combinatorial class X; some mentioned properties are hamiltonian path, graph diameter, exhaustive and random generation, and ranking and unranking algorithms.**

***Keywords-pattern-avoiding permutations; binary strings, constructive bijection; Hamming distance; combinatorial isomorphism*.**

I. INTRODUCTION

In this paper an *element* denotes a member of a list or set, and a *term* denotes a term in a string or sequence. Let $x = x_1 x_2 \ldots x_n$ and $y = y_1 y_2 \ldots y_n$ be two strings of same length. We say x and y are *piecewise comparison* if $x_i \le x_j$ whenever $y_i \le y_j$. Let $[n]$ be the set of all non-negative integers less than or equal to n. We denote by S_n the set of all permutations of $[n]$ and its cardinality is obviously $n!$. Let $\pi \in S_n$ and $\tau \in S_k$ be two permutations, $k \le n$. We say π *contains* τ if there exists k integers $1 \le i_1 < i_2 \ldots i_k \le n$ such that *subsequence* $\pi_{i_1} \ldots \pi_{i_k}$ is piecewise comparison to τ, in such context τ is usually called a *pattern*. We say that π *avoids* τ, or π is τ-*avoiding*, if such subsequence does not exist. The set of all τ-avoiding permutations in S_n is denoted by $S_n(\tau)$ and $s_n(\tau)$ is its cardinality. For an arbitrary finite collection of patterns T, we say π avoids T if π avoids any $\tau \in S_k$; the corresponding subset of S_n is denoted by $S_n(T)$ while $s_n(T)$ is its cardinality. For examples, let $T = \{123,231,1324\}$ is a set of patterns. Clearly permutation $1234567 \notin S_7(T)$ since it contains 123, permutation $652341 \notin S_6(T)$ since it contain 234 which is piecewise comparison to 123 (and also 231 and 341 which are piecewise comparison to 231), while permutation $4321 \in S_4(T)$ since it not contain any subsequence which is piecewise comparison to any pattern of T. Also $s_3(123) = 5$ because $S_3(123) = \{132, 213, 231, 312, 321\}$.

Fundamental questions about pattern-avoiding permutations problems are:

1. to determine $s_n(T)$ viewed as a function of n for given T,
2. to find an explicit bijection (a one-to-one and onto correspondence) between $S_n(T)$ and $S_n(T')$ if $s_n(T) = s_n(T')$, and
3. to find relations between $S_n(T)$ and other combinatorial structures.

By determining $s_n(T)$ we mean finding explicit formula, or ordinary or exponential generating functions. From these researches, a number of enumerative results have been proved, new bijections found, and connections to other fields established.

Problems of pattern avoiding permutations appeared for the first time when Knuth [5], in his text book, posed a sorting problem using single stack. This problem actually is the 312-patterns avoiding permutations. In the other section of his book, he showed that the cardinality of all three-length-patterns-avoiding permutations is the Catalan numbers. Investigations on problems of pattern avoiding permutations then become wider to some set of patterns of length three, four, five, and so on, some combinations of these patterns, generalized patterns, and permutations avoiding some patterns while in the same time containing exactly a numbers of other patterns.

Pattern avoiding permutations have been proved as useful language in a variety of seemingly unrelated problems, from theory of Kazhdan-Lusztig polynomials, to singularities of Schubert varieties, to Chebyshev polynomials, to rook polynomials for a rectangular board, to various sorting algorithms, sorting stacks and sortable permutations [4], statistic permutation [6], also in practical application such as on cryptanalysis (see [7] for example).

The first systematic study of patterns avoiding permutations undertaken in 1985 when Simion and Schmidt [9] solved the problem with patterns come from every subset of S_3. The idea of this paper is the following propositions,

Proposition 1 (see [9]) The number of (123,132)-avoiding permutations in S_n, $n \ge 1$ is $s_n(123,132) = 2^{n-1}$.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Proof. Let $\pi \in S_n(123,132)$. If $\pi_n = n$ then $\pi = (n\text{-}1)(n\text{-}2)...1n$. If $\pi_k = n$ then $\pi_1 > \pi_2 > ... > \pi_{k\text{-}1}$ in order to avoid 123; on the other hand, in order to avoid 132, $\pi_i > (n\text{-}k)$ if $i < k$. Hence, $\pi_i = n\text{-}i$ for $1 \le i \le k\text{-}1$, while $\pi_{k+1}\pi_{k+1}...\pi_n$, must be a (123,132)-avoiding permutation in $S_{n\text{-}k}$. Thus, $s_1(123,132) = 1$, and for $n > 1$, $s_n(123,132) = 1 + \sum_{k=1}^{n-1} s_k(123,132)$. The solution for this recurrence relation is: $s_n(123,132) = 2^{n\text{-}1}$. □

The cardinality of set $S_n(123,132)$, as stated by Simion-Schmidt, is the number of elements of $B_{n\text{-}1}$, the set of all binary strings having length (n-1) without any restriction. This paper gives (in the next section) constructive bijection between $B_{n\text{-}1}$ and $S_n(123,132)$. Then, in section 3 we show that this bijection is actually isomorphism. Remark that is not always the case: a bijection between combinatorial classes may magnify the distance between two consecutive objects. This result allows us to construct in section 4 a Gray code for $S_n(123,132)$. In the final part some concluding remarks are given.

II. CONSTRUCTIVE BIJECTION BETWEEN B_{n-1} AND $S_n(123,132)$

Simion and Schmidt proved that cardinality of set $S_n(123,132)$ is $2^{n\text{-}1}$, but the $2^{n\text{-}1}$ is also cardinality of $B_{n\text{-}1}$, set of all binary strings of length n-1. Theoretically it must be exists a bijection between $S_n(123,132)$ and $B_{n\text{-}1}$; here we construct such a bijection.

The general pattern of $\pi \in S_n(123,132)$, as is mentioned in Proposition 1, can be described as three parts as,

$$\pi = \underbrace{\pi_1\pi_2\cdots\pi_{k-1}}_{(1)}\underbrace{\pi_k}_{(2)}\underbrace{\pi_{k+1}\cdots\pi_{n-1}\pi_n}_{(3)} \qquad (1)$$

where

1. $\pi_1 = n$, $\pi_2 = n\text{-}1$, ..., $\pi_{k\text{-}1} = \pi_{k\text{-}2} = 1$, (eventually empty)
2. $\pi_k = n$,
3. $\pi_{k+1}...\pi_n \in S_{n\text{-}k}(123,132)$ (also, eventually empty)

For example, Figure 1 is the matrix representation of permutation $6573421 \in S_7(123,132)$.

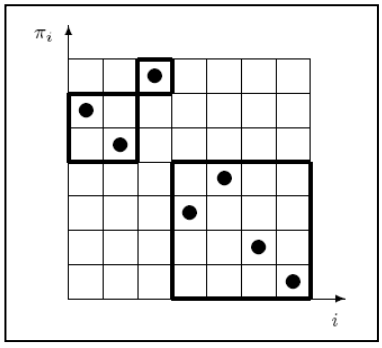


Figure 1. $\pi = 6573421 \in S_7(123,132)$ consist of three part as is mentioned by (1). Notice that the third part is an element of $S_4(123,132)$, the first stage in the verification of $\pi = 6573421$ as element of $S_7(123,132)$ recursively using (1).

For example, Figure 1 is the matrix representation of permutation $6573421 \in S_7(123,132)$.

If we trace the terms of π in (1) from the left to the right, at first we will find π_1 as the second largest term in π (after n). If we remove π_1, then π_2 again will be the second largest, and so until $\pi_{k\text{-}1}$. Next, $\pi_k = n$ is the largest term of π. This tracing and interpretation is similar for the third part of π until one place before the largest term.

Now, we associate $\pi \in S_n(123,132)$ to s, a binary string of length (n-1), and assign the largest of π whenever we find 1 in s and assign the second largest of π whenever we find 0 in s. It is easy to see that this construction is a bijection, so we get the following proposition:

Proposition 2 For each $n \ge 1$, there exists a constructive bijection between $B_{n\text{-}1}$ and $S_n(123,132)$.

Proof. Let $s = s_1s_2...s_n \in B_{n\text{-}1}$. We construct its corresponding $\pi \in S_n(123,132)$ by determining π_i, $1 \le i < n$, as follows: *if* $X_i = \{1, 2, ..., n\} - \{\pi_1, \pi_2, ..., \pi_{i\text{-}1}\}$, then set:

$$\pi_i = \begin{cases} \textit{largest element in } X_i \textit{ if } s_i = 1 \\ \textit{second largest element in } X_i \textit{ if } s_i = 0 \end{cases} \qquad (2)$$

and π_n is the single element in X_n. For examples, $0000 \in B_4$ produces $43215 \in S_5(123,132)$, $10110 \in B_5$ will produce $645312 \in S_6(123,132)$, and $010110 \in B_6$ will produce $6745312 \in S_7(123,132)$. □

Table I shows the set B_4 together with its image, the set $S_5(123,132)$.

TABLE I. THE LIST B_4 AND ITS IMAGE, $S_5(123,132)$, BY BIJECTION (2).

rank	***B₄***	***S₅(123,132)***
1	0000	43215
2	0001	43251
3	0011	43521
4	0010	43512
5	0110	45312
6	0111	45321
7	0101	45231
8	0100	45213
9	1100	54213
10	1101	54231
11	1111	54321
12	1110	54312
13	1010	53412
14	1011	53421
15	1001	53241
16	1000	53214

III. ISOMORPHISM BETWEEN B_{n-1} AND $S_n(123,132)$

A graph associated with a combinatorial class is a graph where objects of the class act as vertices of the related graph. Two vertices of this graph are connected (or adjacent) if the associated two combinatorial objects *are closed*, that is fulfill a predetermined condition(s), usually in the term of Hamming

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

distances. Two graphs G and H are said to be isomorphic if there is a bijection φ such that (u,v) is an edge in G if and only if $(\varphi(u), \varphi(v))$ is an edge in H.

Before exploring the graph associated with the combinatorial classes B_{n-1} and $S_n(123,132)$ and showing the isomorphism between the two graph, we define the closeness properties of two elements of B_{n-1} and $S_n(123,132)$ and then give a theorem concerning the isomorphism.

Definition 1

1. Two binary strings B_{n-1} are closed if they differ in a single position.
2. Two permutations in $S_n(123,132)$ are closed if they differ by a transposition of two terms.

Theorem 1 The bijection (2) is a combinatorial isomorphism, that is, two binary strings in B_{n-1} are closed if and only if their images in $S_n(123,132)$ under this bijection are closed.

Proof. Let x and x' be two elements of B_{n-1} which differ at position i, and also, without loss of generality, let $x_i = 1$, and:

$$x = x_1...x_{i-1}10...01x_{j+1}...x_{n-1}$$
$$x = x_1...x_{i-1}00...01x_{j+1}...x_{n-1}$$

With the contiguous sequence of *0*s: $x_{i+1} = x_{i+1} = ... = x_{j-1} = 0$ eventually empty.

- If x_j until x_{n-1} is 0 then $\pi_n = (m\text{-}1)$ for π and m for π'.
- Let m be the largest element in X_i as is mentioned in (2). Let $\pi, \pi' \in S_n(123,132)$ the images of x and x' by the bijection (2), clearly $\pi_i = m$, $\pi_{i+1} = (m\text{-}2)$, and so on, while $\pi_1' = (m\text{-}1)$, $\pi_{1+1}' = (m\text{-}2)$, and so on. Then the shapes of π and π' are:

$$\pi = \pi_1... \pi_{i-1}\, m\, (m\text{-}2)\, ...\, (m\text{-}j\text{+}i\text{+}1)\, (m\text{-}1)\, \pi_{j+1}... \pi_{n-1}\, \pi_n$$

$$\pi' = \pi_1... \pi_{i-1}\, (m\text{-}1)\, (m\text{-}2)\, ...\, (m\text{-}j\text{+}i\text{+}1)\, m\, \pi_{j+1}... \pi_{n-1}\, \pi_n$$

The case for $x_i = 0$ is similar. □

Since (3) is cyclic, we can draw an $(n\text{-}1)$-cube graph of B_{n-1} and also we can find at least a Hamiltonian cycle in the graph. And since (2) is an isomorphism, we also can draw a congruent graph of $S_n(123,132)$ and also can find the Hamiltonian cycle. Figure 2 shows the two graphs for $n = 4$ together with one of their Hamiltonian path.

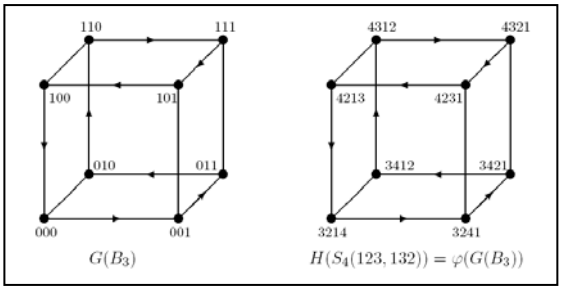


Figure 2. Isomorphism between graph B_3 and graph $S_4(123,132)$. This figure also shows a Hamiltonian cycle in each graph, as is indicated by the arrows. Notice that the Hamiltonian path in $S_4(123,132)$ is the isomorphic image of the path in B_3

IV. Gray code for $S_n(123,132)$ and the Hamming distances

A binary string is a string over a binary alphabet, {0,1}. The set of binary strings of length p codes the set of non-negative integers over closed interval $[0, 2^p\text{-}1]$. For example, set of all 3 length binary strings is {000, 001, 010, 011, 100, 101, 110, 111} and represents set of all non-negative integers less than or equal to 7, the all non-negative integers over the closed interval $[0, 2^3\text{-}1]$.

A Gray code for binary strings is a listing of all p length p binary strings so that successive strings (including the first and last) differ in exactly one bit position [8]. The simple and best-known example of Gray code for binary strings is binary reflected Gray code which can be described the following recursive definition:

$$B_p = \begin{cases} \varepsilon & p = 0 \\ 0 \cdot B_{p-1} \circ 1 \cdot \overline{B}_{p-1} & p \geq 1 \end{cases} \quad (3)$$

where ε is empty string, $\alpha \cdot \overline{B}$ is the list obtained by concatenation α to each string of $\overline{B}$, $\circ$ is concatenation operator of two lists, and $\overline{B}$ is the list obtained by reversing B. $First(B_p) = 0^p$ since it is constructed by recursively concatenation 0 to ε and so on in p times, while $Last(B_p) = 10^{p-1}$ since it just concatenation 1 to $First(B_{p-1})$ and since $Last(\overline{B}_p) = First(B_p)$. For examples, $B_1 = \{0, 1\}$, $B_2 = \{00, 01, 11, 10\}$, and $B_3 = \{000, 001, 011, 010, 110, 111, 101, 100\}$.

Since the first and last elements of B_p also differ in one bit position, the code is in fact a cycle. Generating of (3) can be implemented efficiently as a loop free algorithm [1]. Note that, since a binary Gray code is a cycle, it can be viewed as a Hamilton cycle in the n-cube.

Existence of at least a Hamiltonian cycle in the graph of $S_n(123,132)$, as is showed in the last part of the previous section, is an indication that there is at least a Gray code for $S_n(123,132)$. Since there is a bijection between B_{n-1} and $S_n(123,132)$, here we construct a Gray code for $S_n(123,132)$. By considering bijection (2), Gray code B_p (3) is transformed into following Gray code for $S_n(123,132)$:

$$S_n(123,132) = \begin{cases} \{1\} & n = 1 \\ (n-1) \cdot S^*_{n-1}(123,132) \circ & \\ \quad n \cdot \overline{S}_{n-1}(123,132) & n \geq 2 \end{cases} \quad (4)$$

where $S^*_{n-1}(123,132)$ is $S_{n-1}(123,132)$ after replacing $(n\text{-}1)$ with n. This replacement is taken place since 0, which is the prefix to the first part of (3), is associated to $(n\text{-}1)$, *the second largest element* as is mentioned in (2). Hence $(n\text{-}1)$ must be prefix to the second part of (4). For examples, $S_2(123,132) = \{12, 21\}$, $S_3(123,132) = 2\cdot\{13, 31\} \circ 3\cdot\{12, 21\} = \{213, 231, 321, 312\}$. Table 1. shows the list of B_4 together with its image, the list of $S_5(123,132)$.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

The recursively properties of (4) imply $First(S_n(123,132)) = (n\text{-}1)(n\text{-}2)...1n$. In the other hand, since $Last(\overline{S}_{n-1}(123,132)) = First(S_{n-1}(123,132))$, so $Last(\overline{S}_n(123,132))$ must be $n\cdot(n\text{-}1)\cdot(n\text{-}3)...1(n\text{-}1)$.

Proposition 3. The Hamming distance between two consecutive elements of $S_n(123,132)$ is 2 and, except between the first and the last, the two different terms are adjacent.

Proof. For $n = 2$ the Hamming distance is between 12 and 21 which is 2. For $n > 2$, Hamming distance between two consecutive elements of $S_n(123,132)$, except between the first and last elements, is determined recursively by the distance in the smaller list, and so on, and finally by the distance in $S_2(123,132)$ which is 2. Concatenating $(n\text{-}1)$ and n, respectively to the two parts of (4), of course will not change the Hamming distance values in each part. Also, replacing $(n\text{-}1)$ with n in $S^*_{n-1}(123,132)$ will not change the Hamming distance between each its two consecutive elements. So we only must to check the Hamming distance between $Last((n-1)\cdot S^*_{n-1}(123,132))$ and $First(n\cdot\overline{S}_{n-1}(123,132))$, as follow:

$$\begin{aligned} &Last((n-1)\cdot S^*_{n-1}(123,132)) \\ &\quad = (n-1)\cdot Last(S^*_{n-1}(123,132)) \\ &\quad = (n-1)\cdot n\cdot Last(S_{n-2}(123,132)) \end{aligned}$$

$$\begin{aligned} &First(n\cdot\overline{S}_{n-1}(123,132)) \\ &\quad = n\cdot First(\overline{S}_{n-1}(123,132)) \\ &\quad = n\cdot(n-1)\cdot Last(S_{n-2}(123,132)) \end{aligned}$$

Clearly the Hamming distance between $Last((n\text{-}1)\cdot S^*_{n-1}(123,132))$ and $First(n\cdot\overline{S}_{n-1}(123,132))$ is 2 and adjacent. □

The Hamming distance between the first and the last element of $S_2(123,132)$ is also 2, but the two terms are parted by $(n\text{-}2)$ other terms since the first element is the image of 0^{n-1}, namely $(n\text{-}1)(n\text{-}2)...1n$, while the last is the image of 10^{n-2}, namely $n(n\text{-}2)(n\text{-}3)...1(n\text{-}3)$.

V. Concluding Remarks

Isomorphism between graph of B_{n-1} and graph of $S_n(123,132)$ is more simple than isomorphism between graph of F_{n-1} and graph of $S_n(123,132,213)$, where F_{n-1} is the set of binary strings of length $(n\text{-}1)$ having no 2 consecutive 1s. The constructive bijection between F_{n-1} and $S_n(123,132,213)$ showed by Simion-Schmidt [9]. There is no Hamiltonian cycle in this case, while Hamming distance between two consecutive elements of $S_n(123,132,213)$, a Gray code for $S_n(123,132,213)$, is also 2, as is showed by Juarna-Vajnovszki [3, 2].

References

[1] J.R. Bitner, G. Ehrlich, and E.M. Reingold. Efficient generation of the binary reflected Gray code. *Communication of the ACM*, 19(9):517-521, 2008.

[2] A. Juarna and V. Vajnovszki. Combinatorial Isomorphism Between Fibonacci Classes. *Journal of Discrete Mathematical Sciences and Cryptography*, II(2), 2008.

[3] Asep Juarna and Vincent Vajnovszki. Isomorphism between classes counted by Fibonacci numbers. *Words 2005*, pages 51-62, 2005. UQAM - Canada.

[4] Sergey Kitaev and Toufik Mansour. A Survey on Certain Pattern Problems. Technical report, University of Kentucky, 2003.

[5] Donald E. Knuth. *The Art of Programming*, volume I. Addison Wesley, Reading Massachusetts, 1973.

[6] M. Barnabei, F. Bonetti, and M. Silimbani. The Descent Statistic on 123-Avoiding Permutations. *Seminaire Lotharingien de Combinatoire*, (63), 2010.

[7] Nicolas T. Courtis, Gregory V. Brad, Shaun V. Ault. Statistics of Random Permutation and the Cryptanalysis of Periodic Block Ciphers. *J. Math. Crypt.*, (2):1-20, 2008.

[8] Carla Savage. A Survey of Combinatorial Gray Code. *SIAM Review*, :605-629, 1997.

[9] Rodica Simion and Frank W. Schmidt. Restricted Permutations. *Europ. J. Combinatorics*, (6):383-406, 1985.

Authors Profile

A. Juarna is a combinatorlist at Faculty of Computer Science and Information Technology, Gunadarma University, Indonesia. He got his Ph.D *dual degree* in Combinatorics from Universite de Bourgogne-France under supervising of Prof. Vincent Vajnovszki and from Gunadarma University under supervising of Prof. Belawati Widjaja. Some of his papers were presented in some conference such as Words-2005, CANT-2006, GASCom-2006, and some others are published in some journals or research reports such as CDMTCS-242 (2004), CDMTCS-276 (2006), The Computer Journal 60(5)-2007, Taru-DMSC 11(2)-2008.

A.B. Mutiara is a Professor of Computer Science. He is also Dean of Faculty of Computer Science and Information Technology, Gunadarma University, Indonesia.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

An Investigation of QoS in Ubiquitous Network Environments

Aaqif Afzaal Abbasi, Mureed Hussain

***Abstract*— Quality of Service (QoS) provisioning is a critical issue when it is applied to networks, consisting of different Architectures, Schemas and Technologies. The Resource Reservation Control Mechanisms and the ability of Priority Assignment up to desired Performance levels are must for ensuring QoS Standards. The paper briefly reviews QoS framework Architectures and derive their shortcomings for improvement in Degradation/ Attenuation and Network Service Congestion Control issues in Ubiquitous Network Environments.**

***Keyword*: QoS, Ubiquitous, Mobility, Handover, Performance, Heterogenous Networks.**

I. INTRODUCTION

As Network technologies, Services and Applications are developing rapidly; the aim has shifted from market capturing and financial goals to delivering Quality of Service (QoS) that is better or equal to its previous technology and legacy equipment.

The Service provider networks have trusted brands for which maintenance is critical. The challenge of making communication simpler and cheaper, with its availability and flexibility to adapt to new technology/ service environments, gave rise to ubiquitous networked computing infrastructures.

It is considered , that the recent evolution in wireless networks would help in utilizing different access technologies like the WLAN(standard 802.11x), WWANs such as General Packet Radio Service (GPRS), Universal Mobile Telecommunications System (UMTS), Code Division Multiple Access (CDMA) and WiMAX (World Wide Interoperability for Microwave Access), Wireless Mesh Networks and other emerging access technologies. The main focus of collaboration of miscellaneous wireless technologies is providing Ubiquitous access to highly demanded services. Each one of above mentioned technology has its own specification in term of QoS level, Coverage area, Bandwidth, Congestion control mechanism and Cost. The incoming Mobile Terminals (MTs), like the smart phones and PDAs, would be capable of Multimode Access Interface in supporting different types of radio access technologies on single equipment [8].

Qualities of Service (QoS) parameters are key factor in development of new technologies. The QoS specifications and Interoperability based QoS parameters are gaining importance as networks become interconnected and a large number of operators and providers interact to deliver communications using one-for-all infrastructure.

The fast induction of cellular systems in our normal life, in addition to the large scale Internet bandwidth consumption has made us think for convergence mechanism trend for supporting Internet mobile users [3].

In this paper, we shall study the research being performed for QoS enhancement in Ubiquitous Networks. The papers reviewed were analyzed for common problems being faced in QoS achievement. Section 2 briefly explains the work conducted, in comparison to their derived results summary. Section 3 will judge reviewed papers in context of Strengths and Limitations. We will conclude this paper Section 4 and would direct guidelines for future in Section 5.

II. LITERATURE REVIEW

The paper reviews Quality of Service Infrastructures for Ubiquitous Network Environments in prospect of Efficiency, Authenticity and Compatibility. The work underlines the research being done in delivering Quality of Services for WWANs, Personal Ubiquitous Environments, Wireless Mesh Networks and GPRS based technologies.

In [1], the authors explore the design of an efficient imperative handover mechanism using the Y-Comm Framework. It also underlines the development of a new test bed to further investigate the proposed mechanism.

The paper explored the reactive policies by using the Cambridge Wireless Test bed with simulations results.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

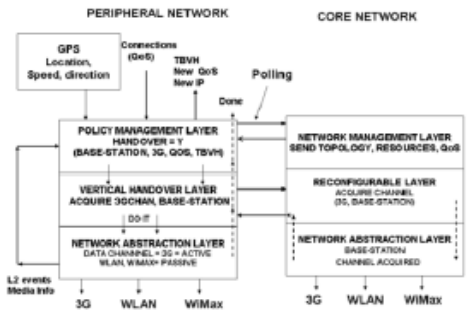
The paper's proposed mechanism has started operations on Y-Comm test bed for algorithmic mechanisms including the Vertical Handover.

The paper briefly expressed the mechanism for support of efficient vertical handover using the Y-Comm Framework. The authors believe that adoption of their proposed mechanism would enhance the seamless connectivity issues. They are proceeding to build a test bed for performance evaluation of their proposed design in a real environment.

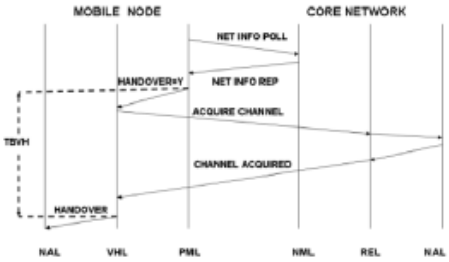
The paper discussed detailed results and presented improvement methods in Handover performance. It also highlighted the development of a new test bed for further investigation of proposed mechanisms.

The proposed mechanism is not yet tested in a real environment. Proactive policies discussed have only been tested through simulation values.

Figure 1: Proactive handover and its sequence.[1]



Proactive Handover

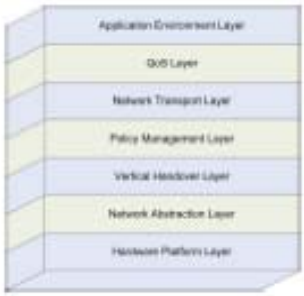


Proactive Handover Sequence

In [2] the authors focused the handover issue of QoS. They proposed to devise a framework that encapsulates the issue of heterogeneity in general and handover in specific. The proposed model resembles the structure of OSI model so as to clearly mark the layers and their functionality.

The proposed layout consists of 7 layers namely Hardware Platform Layer, Network Abstraction Layer, Vertical Handover Layer, Policy Management Layer, Network Transport Layer, Quality of Service (QoS) Layer, and finally the Application Environment Layer.

Figure 2: Conceptual Layered structure from [2]



A proactive system working on the basis of simulated environment and mathematical modeling is used for development of mathematical models for Time before Vertical Handover in upward handover scenario with WLAN network in range and making it unavailable on the basis of velocity and trajectory of the mobile node.

A precise definition of a context as well as interstitial functions is being made. The work is more focused on examining End-to-End Transport issues. The aim is to first develop a flexible method for network specification and definition of characteristics like addressing and naming.

The paper models an algorithm for allowing users to quantify their amount of bandwidth usage prior to their proceedings for a journey. The current available networks have the ability to respond the described handoff techniques.

The proposed concept has not yet finalized the proactive policy mechanisms as the coverage maps of ubiquitous networks component networks are being built at University of Cambridge.

In [3], a study result to determine Fast Handovers for Mobile IPv6 under extreme cases in comparison with the Baseline Mobile IPv6, for a hot spot public environment was conducted.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

The paper discusses protocol behavior and performance level of Fast Handovers for Mobile IPv6 (FMIPv6) with respect to baseline Mobile IPv6 (MIPv6) protocol. The focus was mainly laid on evaluating two parameters:

1. Degradation of QoS a mobile user perceives during a handoff / data stream reception (Video or VoIP).
2. Signaling load costs related to Mobile IPv6 and its enhancement.

Interest was targeted in performance metrics like handoff latency, packet loss rate, obtained bandwidth per station and signaling load. Varying traffic source impacts were related (CBR, video, VoIP and TCP transfers).

The scenario chosen in the case study is similar to a 'building block' of a potential wireless LAN 'hot spot'. With composition of around four access routers and up to 50 mobile nodes moving randomly across it, and continuously communicating like the IEEE 802.11 wireless LAN standard.

The Random Waypoint Mobility Model was used for the random movement.

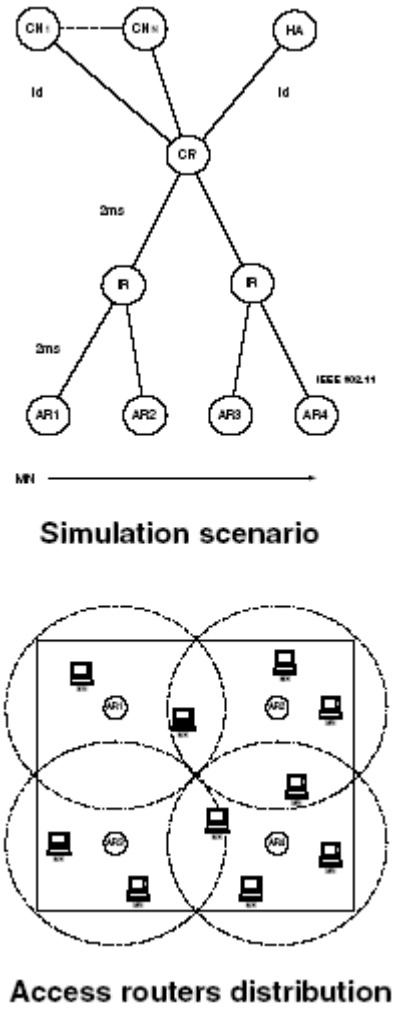
The study considered various impact parameters like mobile nodes number, rate of handoffs, correspondent nodes number, unwired link delays, movements and protocol options over performance metrics.

As the topic gets complexity and broadness with respect to time, simulation was chosen as the most suitable analysis method by using NS 2 simulator.

Though the analysis performed is a deep insight on overall system performance of protocols and their causes, the results provided quantitative results for Mobile IPv6 and Fast Handovers for Mobile IPv6 of the overall system performance. It checked whether or not they performed as expected in a real scenario? It provided the reasoning behind the impact of the parameters over the performance of both protocols in saturation and no saturation conditions where the behavior was different to the expected one.

The study is a simulation result and have missed practical major parameters like angle deviation attenuation, whether dependent factors and many more.

Figure 3: An Access Point Distribution for a Simulation Scenario from [3]



In [4], the authors proposed a new QoS Control Architecture, where optimum pair of Access Network and route in Core Network is selected per communication flow channel, each requiring a Quality of Service assurance. On the basis of the Access network, Core routing status, and costs were calculated.

The architecture defined, is laid on a mesh of Access Network's selection technology, Core Route Selection mechanism, Routing Management Strategy Permissions.

Based on the QoS End-to-End Ensured Communication, an Architecture is presented where focus is laid on Dynamic Information Correction, Admission Control, Route Selection, Route Control and End Terminal Movement Detection.

The route selection algorithm explains the

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

efficient Access Network and Core Network Route Selection. The algorithm is set to evaluate the cost of a link based on its no-utilized bandwidth alongside its load-balancing issues.

The algorithm evaluation used 4 edge nodes for server connections. The Bandwidth of links were 2.4 Gbps (among core network routers), 2.4 Gbps (between server edge and core network routers) and 1 Gbps for other links.

The simulated results demonstrate that performance degradation was avoided by the core network QoS control as the traffic was assured in the core network even when the traffic travelled through the congested point. Another proposed scenario depicted the proposed route selection methods performance as satisfactory.

The proposed structure and its simulated results, are a brief methodology for ensuring desired QoS in dual mode mobile terminals, dealing multiple access networks simultaneously.

The cost evaluation of link in simulation process lacks flexibility as load balancing is performed for unused bandwidth rather than applying a cost for available and in-use bandwidth.

The proposed QoS control architecture and optimum route selection path helped in avoiding congestion states and increasing the QoS guaranteed communications tremendously. The same can be implemented for rectification of QoS based issues.

In [5], authors proposed a class consisting of MAC protocols based on binary countdown for demonstrating differentiation capability. The research was focused at developing access strategy so as to achieve the strong QoS capability, high throughput and control/ support.

The proposed technique overcomes collision/ hidden terminal problems in multihop networking environments, and considerably reduces the communication overheads/idleness introduced by inducing a Detached Dual Binary Countdown (DDBC), a subclass of Dual Prohibition Multiple Access (DPMA) that replaces the functionality of RTS/CTS dialogues with prohibiting signals.

The resultant protocol inherits important advantages from binary countdown including collision self-determination/controllability, prioritization capability, and purging hidden terminals.

Here all competing nodes get synchronized, and start competition simultaneously. The signals transmit in a channel, committed for control, while data packets are transmitted in a separate channel, where each intended transmitter/receiver-pair coordinates in advance, so as to decide competition for participation.

The proposed solution has an advantage that the class of protocols may either reduce or completely terminate collision rate. This collision rate issue is mostly overlooked in QoS MAC and sensor MAC protocol suit infrastructures. It is obligatory for QoS and energy-efficient MAC to follow otherwise it would be degraded due to increased backoff delay, and needless waste of energy.

The paper limits in discussing coordination mechanisms as if one of the preceding conditions dissatisfy, higher-priority packets are blocked by the available nearby lower-priority packets. The participation of transmitter/receiver-pair coordinates and their proposed Competition Number (CN) function is not discussed in detail in the paper.

The paper proposed a Detached Dual Binary Countdown (DDBC) for Multihop Wireless Networks DDBC. The proposed mechanism helps control messages, and collision problems. It can resolve the hidden and exposed terminal issues without depending upon interference.

In [6], the authors explain the QoS structural design and its analogous QoS signaling protocols for their development and deployment in Daidalos project.

The paper discuss QoS components and its limit area, Edge network and their applications, QoS Services, Signaling Scenarios and amalgamation of QoS signaling with application signaling in mobility perspective.

The proposed QoS Architecture as shown in Figure 4 depicts a core network, with each administrative domain connected to other domains through edge routers (ER).

In each access network, Mobile Terminals (MT), Laptops and PDAs are connected to the network through Access Routers (AR). Every MT is integrated with a QoS client table to request QoS resources.

The architecture works with the principle of a QoS Broker's admit management and network administration. While performing load balancing and creating sessions among networks for optimization of resources, ,the QoS Brokers in the core network (CNQoSB) manage the core resources in terms of Aggregation. The Access Network (AN), supports Service Provision Platform (SPP) in the core network. The MultiMedia Service Proxy (MMSP) controls Multimedia sessions. QoS definitions at the domain level are provided by a Policy Based

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Network Management System (PBNMS). For authentication and accounting purposes, an Authentication, Authorization, Accounting, Auditing and Charging (A4C) Server is also present in each domain. The AR contains functions consists Connection tracking and translation to other QoS reservation mechanisms, similar to the Integrated Services (IntServ).

Figure 4: An illustration of the Daidalos QoS Network Architecture from [6].

The architecture discussed has advantage/ edge in terms of capacity to administer End-to-end QoS in a heterogeneous mobile environment. For miscellaneous services, multimedia, unicast and multicast, it has the capability of utilizing optimized network resources.

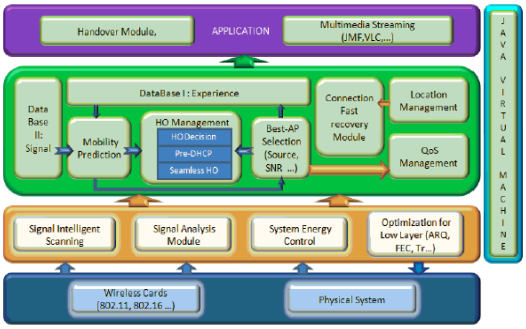
The issue in the proposed architecture is that the model provides end-to-end QoS to the application flows with enough resources, and requires its presence a must during the entire process flow path.

The QoS is also explained with specification of the Intra and Inter domain QoS control. QoS organization, Policy Based Network Management System and a Real-time Network Monitoring system with the ability of assisting Admission control and result oriented active and passive measurements were discussed. The components, interfaces and functionalities taken into consideration, with multicast services and broadcasting networks were taken in deep discussion.

In [7], authors proposed a novel middleware for the Mobility Management Over the Internet, so as to execute proficient and context-aware mobility management, such that it can satisfy new mobility requirements like Dynamical Location Management, Quick Handover, and consistent connection support.

The proposed middleware model consists of 9 modules, including Signal Analysis module (SA); the Energy Control module (EC); the MAC layer Optimization module (MO); the Geo-Location module (GL); the Location Management module (LM); the Mobility Prediction module (MP); the Hand Over module (HO); the QoS Management
module (QM); and finally the Seamless Streaming Support module(SS), as shown below;

Figure 5: A model of proposed Middleware from [7]



The Signal Analysis Module allows an intelligent collection and analysis of the signal information from lower layers. The Energy Control module collects system resources in real time environment as upper layers in Wireless Networks cannot judge available bandwidth, MAC Layer Optimization corrects this deficiency. GL performs Signal Propagation Model Printing. LM delivers end to end location management support. The MP module provides mobile nodes a context-aware environment and helps to take proactive measures in order to guarantee different services. HO basically performs QoS Handovers, its delay minimization and best Access Point selection. SS is an extension of Java Media Frame work, which enhances media streaming.

The two typical scenarios, describe the Application at the transport layer for several error control and intelligent rate control Mechanisms. The QoS cross layer information exchange, QoS delivered to upper layers and performance anomaly syndrome have been enhanced. The second scenario considers two mobile nodes that transmit/receive multimedia information services to and from each other across different WLAN networks.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

The contribution of paper is that it demonstrates scenarios with benefits for user in terms of QoS enhancement and seamless mobility support.

The presented model has not been tested for over stressed streaming environments and multi-platform network scenarios.

The presented middleware for the mobility management over the internet with integrated novelty framework demonstrated through various theoretical scenarios. The modules involved in Mobility Management Over Internet, can closely cooperate to significantly enhance QoS Mobile Communications.

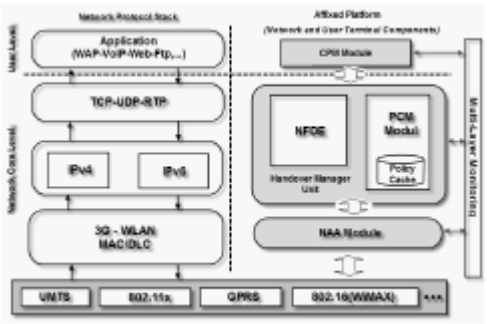
In [8], the authors proposed a network selection algorithm, based on hybrid Neuro-fuzzy concept. It involved low packet loss and latency. The algorithm has been implemented for various scenarios for results analysis.

The algorithm was focused by keeping in view the following parameters of ubiquitous networks;

1- Small handoff latency/ Effective packet delivery.
2- Management Simplicity.
3- Scalability and stiffness.
4- Application transparency.
5- User preferences and service cost.

The proposed method consists of four parts: Connection Profile Manager (CPM), Network Access Assistance (NAA), Neuro-Fuzzy Decision Engine (NFDE), and Peer-bind Connection Manager (PCM) as shown below;

Figure 6: Proposed Multilayer Scheme from [8].



CPM maintains user preference settings for handoff execution.

The decision making for choosing optimal available network is decided by NAA.

For administration/ management in continuity of current session, Peer-bind Connection Manager Module provides peer-to-peer (P2P) technology. PCM contains policy cache which is repository to store connection profile manager in system side.

Decision making for selection of an optimal network, is an uncertain and approximate reasoning problem, solved on Neuro-fuzzy method. NFDE actually is developed on Adaptive Neuro- Fuzzy Logic.

The main advantage of the described model is that it can work without continuous details requests for the system and has explicit knowledge of the underlying process. Due to Neuro-Fuzzy's complementary nature, other technologies can be integrated into it through a number of ways and will make it more optimum.

The weak side for Neuro-fuzzy based methods is associated in finding optimum weight of neurons and appropriation, normalization and complexity of managing fuzzy rules. The network selection method does not consider Triple A's (Authentication, Authorization, and Accounting) among network service providers.

The proposed cross-layer host mobility support with adaptive handoff decision based on Neuro-fuzzy concept, determines whether a vertical handoff should be executed or not. The planned scheme dynamically chooses the optimum connection from available access network technologies, so as to continue with an existing service.

In [9], authors explain a QoS supporting framework for IPv6 based Next Generation Networks (NGN) as shown in Figure 7..

As the NGN would be a blend of multiple technologies, the scalability and seamless mobility for different architectures would require an all-embracing state of the art QoS framework. The described framework guarantees QoS without considering the node's Network Schema, and efficiently handles the offered handovers so as to bring uniformity and optimization in resource distribution.

The framework amalgamates handover scenarios created at layer two and three, in accordance with the prevailing IETF, IEEE standards.

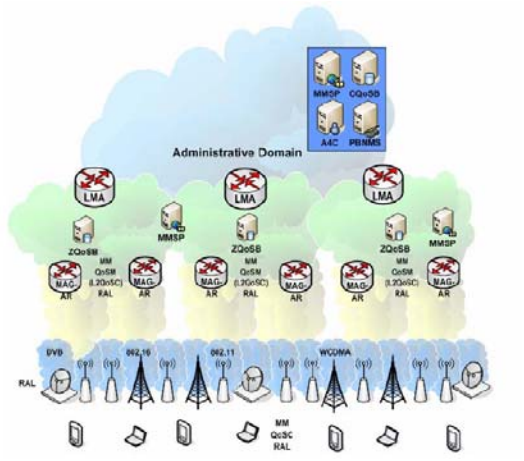
The proposed architecture merge hierarchical organization of data-path network elements into off-path functions control.

QoS control in the framework is performed in a hierarchical manner separating end-to-end QoS control at layer three from QoS control at layer two.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

The network sniffs out the best flow assignment to interfaces, and transmits it to the host which makes the final decision and triggers the required handovers.

Figure 7: Proposed QoS Architecture Schema from [9].



The proposed schema delivers more enhanced features than the work under maturity. It has much flexible handover mechanism, clear integration with 802.21 standards, Multi-homing support and increased resource management competence.

The proposed handover procedure considers handovers initiated by the terminal, but has been enhanced with information given by the Network-assisted Mobile Initiated Handover.

Protocols are being used for accomplishment of the framework, are not bound to any particular solution. Hence they can be used with other protocols for resolving issues like management of local mobility or communication among network elements. This framework can handle the challenges offered in NGNs with a very optimal, flexible and scalable outcome.

In [10], authors discuss End-to-End (E2E) QoS provision scheme in context of 4G Networks. The emphasis was laid on distribution of functionalities among edge routing networks, core network, multi-time multi access networks and mobility achieving hosts. Apart from defining and elaboration of new schemas, existing QoS mechanisms were briefly discussed.

The paper suggests possible QoS mapping techniques among a variety of wireless and fixed techniques and protocols namely GPRS/UMTS and MPLS/DiffServ as shown in Figure 8.

The discussed Intersystem E2E QoS models are suitable for deployment in 4G heterogeneous environments.

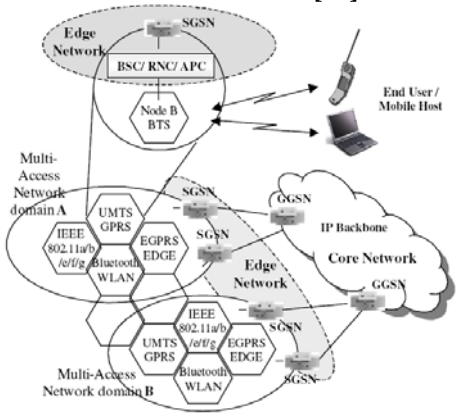
As 4G networks are based on the incorporation of all existing access networks for provision of Always Best Service, mainly 2 two approaches are implemented for coupling WLAN/WPAN with GPRS/UMTS access networks. These are Tight coupling (Using WLAN/WPAN connection to GPRS/UMTS network as an alternative radio access network), and Loose coupling, where the WLAN/WPAN is connected to the gateway GPRS support node as a separate network, and WLAN/WPAN router is treated as a GGSN.

As QoS is an important issue to be addressed to provide acceptable and predictable Classes of Services to the end user, the requirements of real-time and multimedia applications in 4G networks should unified.

The presented All-IP based Multiple Multiple Access Wireless Access Networks (MuMAcWiNs) is a tightly coupled architecture for providing E2E QoS support. The intelligent control of the network along with functions like mobility, monitoring of resources and information organization, is achieved independently of IP-based transport network. This strategy leaves space for further development of control functions without interfering with transport networks. For provision of communications services, in an always moving relative framework among two different access networks, get independent of transport network and control layers.

The paper is worthy as it suggests incorporation of MPLS features in multi-access network domains, particularly inside the controllers.

Figure 8: MPLS Core and Edge Network Formation from [10].



http://sites.google.com/site/ijcsis/
ISSN 1947-5500

The paper has limitation in implementation and results discussion/ analysis.

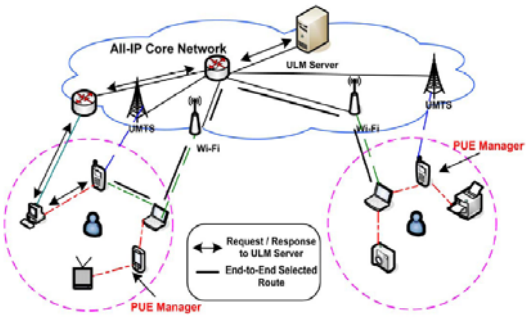
Appropriate QoS support protocols for fixed and mobile wireless networks have been reviewed and GPRS/UMTS mechanisms for CoS encapsulation into MPLS header field have been discussed in detail. Intersystem E2E QoS vision has been proposed in terms of layered protocol architecture blocks with distinctive differentiation of network functionalities in the core, edge, multi-access networks and mobile host. Migration of the functionalities of these network parts, invoked by deployment of the two different QoS schemes has been demonstrated and justified.

In [11], authors address the design of Personal Ubiquitous Environment (PUE) based Mobility Management framework, which influence the IP-based technology to accomplish global roaming among dense heterogeneous networks.

Figure 9 demonstrates and Integrated UE Architecture for Ubiquitous Wireless Neworks.

In order to make this roaming pervasive for the users, the PUE formation, location and handoff management, addressing and network selection techniques are obligatory. For Mobility Management, Integrated Convergence and Personal Network Routing Protocol algorithms respectively were adopted. For Location management and Network selection, Unified Location Management and End to End Environment-aware Network Selection techniques were selected.

Figure 9: An Integrated PUE Architecture for Ubiquitous Wireless Network from [11].



The PUE mobility management architecture was implemented with ICON, PNRP, ULM and 3E network selection algorithms the network simulator, NS-2. The evaluation study, feasibility and the proof-of-concept of proposed architecture and its evaluation/ performance parameters while working with IP mobility management and fast handoff schemes were undertaken.

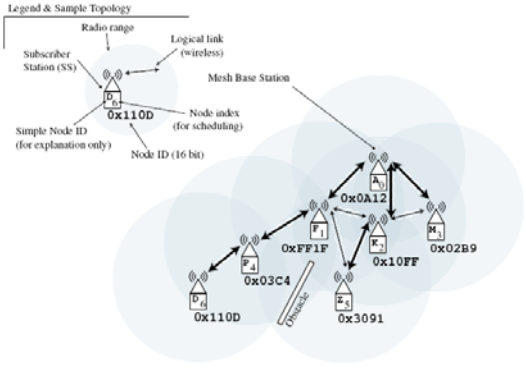
The paper has positive aspects in terms of simulation results demonstrated. The simulation on PUE Mobility Management Architecture effectively offered Seamless Interoperability in Ubiquitous/ Heterogeneous environments. It has a very little impact on the application QoS performance due to frequent handovers.

The paper lacks descriptive over view of proposed framework. Instead it used transfer rates of Handoffs and Interoperability limit slots from other networks. The value obtained does not depict value change with reference to streaming, textual and graphical data modes.

The paper proposed different protocols and components for the Mobility Management Architecture ranging from Personal Ubiquitous Environments addressing, to the End-to-End Network selection. The Cross-network seamless roaming in various application scenarios under PUE mobility management was evaluated and discussed.

In [12], authors highlighted the critical aspects needed to be considered for utilizing the IEEE 802.16-2004 standard's mesh mode as they are predicted for disruptive changes in wireless communication as shown in Figure 10. In addition to the research challenges faced in implementation, authors also highlighted the drawback and gave suggestions so as to realize the QoS in Wireless Mesh Networks.

Figure 10: A Wireless Mesh Network Structure from [12].



In [12], authors opted for a 3 way Wireless Mesh Networks (WMNs) scenarios. In Enterprise Perspective, they are deployed as wireless backbone for provision of backhaul services, e.g. Campus Area Networks. They can be installed in situations where disasters or

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

emergencies are to be handled. Here, communication is performed using wireless hand-held devices. The Mesh in such scenarios are answerable for supporting QoS among the responders and their respective Service Control Centre.

In Operator/Provider Perspective, WMNs are only used for coverage.

In End user perspective, the normal users use them for Peer to Peer data exchange among neighbors and in small scale site offices.

The issue with the IEEE 802.16 standard is that it provides complicated mechanisms for holding up QoS provisioning. It has complex scheduling services and its response to services vary. The handshake mechanism involved, does not provide delay and bandwidth guarantees effectively in distributed scheduling mechanism outlined for bandwidth reservation.

The strength in the paper is that it clearly highlighted the flaws in the structure of WMNs standards and their shortcoming in practical implementation. The congestion and Bandwidth controlling mechanisms were briefly highlighted.

The paper is weak in areas of practical demonstration and detailed model presentation for collision, congestion and bottleneck avoidance.

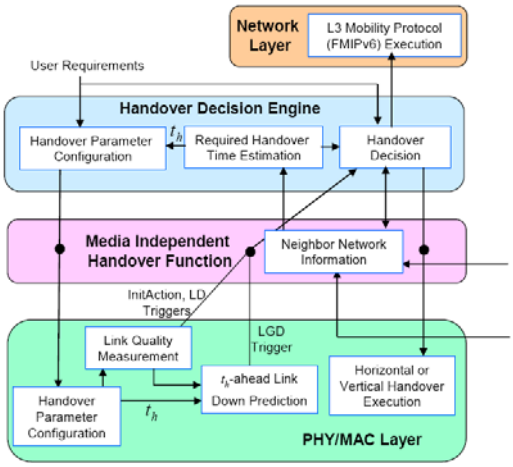
The authors proposed a 3 means approach for achieving QoS. First to develop QoS requirements on basis of application based circumstances and scrutinize their assumptions (induced by that wireless technology/ standard).

Secondly, a belief in justifying the challenge of enabling QoS in WMNs for cross-layer perspectives, as optimization at one protocol layer needs to be considered, the trade-offs and influence at the other layers too. Lastly, during designing of mechanisms, solution must be kept trouble free and crystal clear.

In [13], a new predictive handover framework has been proposed which uses its neighbor network information for timely generation of link triggers. This is helpful in appropriate termination of handover procedures before downing of link. The paper also estimates the required handover time for a given neighbor network, and later using a predictive link triggering mechanism as shown in Figure 11.

The paper presented a Predictive Handover Architecture, with Neighbor network conscious handover procedure, based on (IEEE 802.21 MIHF). The time to complete one handover was estimated. The horizontal and vertical handover costs analysis were performed in comparisons of Varying link down time, Corresponding service disruption time and Total hand over time. A brief simulation and numeric analysis was presented.

Figure 11: Proposed Predictive Handover Architecture with Neighbor Network Information from [13].



The paper presented a new predictive handover mechanism for Seamless Handovers across Heterogeneous wireless networks.

The neighbor network information is being utilized for choosing the required handover policy and handover procedure. From the analysis of the required handover procedures based on the obtained neighbor information, the handover's time estimation was measured.

This weakness is the adaptive and accurate Link Going Down trigger time which provides the low handover cost in terms of the total handover time and the service disruption time.

The presented Predictive Handover Mechanism with Neighbor network aware handover procedure is a complete case with proven simulation results. The proposed predictive handover mechanism can be successfully implemented within the new IEEE 802.21 media independent handover architecture.

The paper's presented Mechanism uses neighbor network information for deciding the desired handover policy. From the analysis required handover time estimation methods for various handover types were presented. The proposed predictive handover mechanism can control low handover cost in terms of the handover time and the hence the service disruption time.

The mechanism is effective for early triggering costs and simulation is being performed to bring refinement in its layout for implementation.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

III. CONCLUSION

With the arrival of multi-interface, multi-services providing networks, there is a dire need of developing new QoS frameworks that can provide services at their best. The paper reviewed the schemas and architectures developed for Ubiquitous networks and explained their functionalities. The purpose of the effort was to analyze the architectures in perspective of scalability, reliability and flexibility. The network resources optimization mobility frameworks were discussed for administering congestions/ bottleneck states with novel, flexible and scalable solutions.

IV. FUTURE WORK

The paper discussed the QoS Schemas in depth. However, a lot is open to discussion and improvements in Cost evaluation of QoS links, Load balancing in network handovers, Transmitter/ receiver-participation of pair coordinates, Reduction of Over stressed streaming environments and Network-assisted Mobile Initiated Handovers.

REFERENCES

[1] Glenford Mapp, Fatema Shaikh, Mahdi Aiash, Renata Porto Vanni, Mario Augusto, Edson Moreira, "Exploring Efficient Imperative Handover Mechanisms for Heterogeneous Wireless Networks", Proceeding of International Conference on Network-Based Information Systems, IEEE Computer Society, 2009, (ISBN: 978-0-7695-3767-2) Washington DC, USA, pp.286-291.

[2] Glenford Mapp, David N. Cottingham, Fatema Shaikh, Pablo Vidales, Leo Patanapongpibul, Javier Balioisian, Jon Crowcroft, "An Architectural Framework for Heterogeneous Networking",Proceeding of International Conference on Wireless Information Systems and Networks (WINSYS), August 7-10, 2006, (ISBN 972-8865-63-5) Setubal, Portugal, pp. 285-292.

[3] Marc Torrent-Moerno, Xavier Perez-Costa, Seastia Sallent-Ribes, "A Performance Study of Fast Handovers for Mobile IPv6",Proceedings of the 28th Annual IEEE International Conference on Local Computer Networks (LCN 2003), October 20-24, 2003, (ISBN:0-7695-2037-5) Bonn, Germany, pp.89-98.

[4] Akiko Yamada, Keiichi Nakatsugawa, Akira Chugo, "End-to-End QoS Control Architecture and Route Selection Method for IP Networks", Fujitsu Scientfic and Technical Journal, October 2006,(ISSN:0016-2523), Osaka, Japan, pp. 523-534.

[5] Chi-Hsiang Yeh, Richard Wu, "Strong QoS and Collision Control in WLAN Mesh and Ubiquitous Networks", 2008 International COnference on Sensor Networks, Ubiquitous, and Trustworthy Computing (SUTC 2008), June 11-13 2008, (ISBN: 978-0-7695-3158-8), Taichung Taiwan,pp. 20-27.

[6] Susana Sargento, Rui Prior, Filipe Sousa, Pedro Goncalves, Janusz Gozdecki, Diogo Gomes, Emiliano Guainella, Antonio Cuevas, Wojciech Dziunikowski, Francisco Fontes, "End-to-end QoS Architecture for 4G Scenarios", IST Mobile & Wireless Communications Summit, 19-23 June 2005, Dresden, Germany, pp.356-361.

[7] Lei Zhang, Patrick Senac, Emmanuel Lochin, Micheal Diaz, "A Novel Middleware for the Mobility Management Over the Internet", 2008 International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM), 23-26 June, 2008, (ISBN:978-1-4244-2099-5), Newport Beach, CA, USA.

[8] Mohammad RazaHeidarinezhad, Zuriati Ahmed Zukarnain, Nur Izura Udzir, Mohamed Othman, "A Host Mobility Support with Adaptive Network Selection Method in Hybrid Wireless Environment",International Journal of Digital Content Technology and its Applications (JDCTA), Vol. 3, No. 1, March 2009, South Korea, pp. 34-39.

[9] Miguel Almeida, Daniel Corujo, Susana Sargento, Vítor Jesus, Rui L. Aguiar, "An End-to-End QoS Framework for 4G Mobile Heterogeneous Enviornments", Proceedings of OpenNet Workshop, 27-29 Mar 2007,Diegem, Belgium , pp. 1-13.

[10] Nino Kubinidze, Mairtino' Droma, Ivan Ganchev, "Intersystem End to End QoS Provision in 4G Heterogeneous Networks",Volume 5, Issue 3, The World Scientific and Engineering Academy and Society (WSEAS) Transactions on Computers, November 2004, Miami, FL, USA, pp.1355-1360.

[11] Usman Javaid, Djamal-Eddine Meddour, Tinku Rasheed, Toufik Ahmed, "Mobility Management Architecture for Personal Ubiquitous Enviornments", IEEE 19th International Symposium on Personal, Indoor and Mobile Radio Communications(PIMRC), 15-18 Sept, 2008 (ISBN: 978-1-4244-2643-0), Cannes, France, pp. 1-5.

[12] Parag S. Mogre, Matthias Hollick, Ralf Steinmetz, "QoS in Wireless Mesh Networks, Challenges, Pitfalls, and Roadmap to its Realization", 17th International workshop on Network and Operating Systems Support for Digital Audio & Video (NOSSDAV'07), June 4-5, 2007, Urbana-Champaign, IL, USA, pp. 119-124.

[13] Sang-Jo Yoo, David Cypher, Nada Golmie, "Timely Effective Handover Mechanism in Heterogeneous Wireless Networks", Military Communications Conference (MILCOM) 2008, San Diego, CA, 17-19 Nov. 2008, pp.26-51.

AUTHOR PROFILES

AAQIF AFZAAL ABBASI is with National University of Sciences and Technology (NUST), Islamabad, Pakistan.
(E-mail: aaqif@ceme.nust.edu.pk)

MUREED HUSSAIN has expertise in Networks Security and Information Engineering.
(E-mail:hmureed@yahoo.com)

Information Agents in Database Systems as a New Paradigm for Software Developing Process.

Eva Cipi
department of informatics engineering,
University of Vlora,
Vlora, Albania,
eva.cipi@yahoo.com

Betim Cico
department of informatics engineering,
Polytechnic University of Tirana,
Tirana, Albania
betim.cico@gmail.com

***Abstract*— This work aims at giving new possible solutions combining an information agents architecture and database techniques in the management of information. We consider agents as powerful tools for handling the systems' complexity and very efficient to bring modularity in software development. Here is presented a case study of an agent-based architecture which uses information agents dedicated to the specific tasks of the business process management and other intelligent agents that will try to extract the knowledge from databases and to offer intelligent decisions.**

Keywords- information agent; database system; software development; multi-agent-based architecture;

I. INTRODUCTION

This work is focused on designing a model of agent based systems which will bring information agents as useful tools in management process of knowledge collection in order to gain many advantages. Intelligent Agents are used for modeling simple rational behaviors in a wide range of distributed applications. Intelligent agents have received various, if not contradictory, definitions; by general consensus, they must show some degree of autonomy, social ability, and combine pro-active and reactive behavior [1]. First we discuss about software agents and databases, the architectures that support traditional DBMS modules; and the need to integrate agent techniques for the increase of the efficiency of knowledge. In general, Database Management Systems are known as passive systems that become active only in response to requests from end users or application programs. A possible approach is to make use of the information agent technology to add a reactive capacity to the system that enables autonomous activity and extensibility. Second we show a simulation that includes four information agents that support four different tasks taking inputs from the same source and giving solutions as suggested messages.

II. RESEARCH OBJECTIVES

The research tries to show the relations between the agents and database techniques. We consider these relations very useful because we believe the agents make their job much faster and much better than other object.

Several interesting questions arise in connection with the current research: Can we find a good model which becomes widely used in database applications? Can we add new services by setting new agents without compromising the processing and time? Can we develop better solutions if we build a new model by combining agents and data mining in database systems? In light of these questions we started to develop an application simulating a business environment. We will note the performance of the system by observing agent behavior. The environment is a software component shielding the agents from details of the real world and providing the interfaces for perception, action and communication to the agents.[2] Modeling a software architecture is an essential step for the development of complex systems, including Multiagent Systems (MAS).[3] Ideal solution is a logical value chain with different components focused on providing the services required for handling time-variant information.[4]

III. INFORMATION AGENTS

An "information agent" is a software agent that is closely tied to a source or sources of data, as opposed to being tied closely to a human user's goals (so called "interface agents"), or the processes involved in carrying out an arbitrary task (so called "task agents").[5] In general such distinctions are necessarily part of a spectrum, but in this document we use the term "information agent" to denote a specific class of implemented agents with certain input/process/output behavior.[6] An information agent is an agent that has access to at least one, and potentially many data sources, and is able to collect and provide information obtained from these sources in order to answer queries given by users and/or other information agents (the network of interoperating data sources are often referred to as intelligent and cooperative information systems). The data sources may be of many types, including, for example, traditional databases as well as other information agents. Finding a solution to a query might involve an agent accessing information sources over a network or a database. Information agent is an autonomous computational software entity that is especially meant to provide a proactive resource discovery, and to offer value-added information services and products. It is capable to provide transparent access to one or many different data sources. [7]

Identify applicable sponsor/s here. *(sponsors)*

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Figure 1 describes the advantages of using information agents as powerful techniques for gathering information and using it to make good decisions in a brief time.

Figure 1. Information agent utilization advantages

IV. AGENTS AND DATABASE SYSTEMS

The integration of both technologies would even increase the complexity of the system. It would be imperative to develop an architecture that is focused on finding one with a high level of abstraction that hides the complexity, with no direct consequences. The most powerful tools for handling things in software development are modularity and abstraction. [8] Agents represent a powerful tool for making systems modular. If a problem domain is particularly complex, large, or unpredictable, then it may be that the only way it can reasonably be addressed is to develop a number of modular components that are specialized (in terms of their representation and problem solving paradigm) at solving a particular aspect of it.

In such cases, when interdependent problems arise, the agents in the system must cooperate with one another to ensure that interdependencies are properly managed. In such domains, an agent-based approach means that the overall problem can be partitioned into a number of smaller and simpler components, which are easier to develop and maintain, and which are specialized at solving the constituent sub problems.

A. Architectures of information agents

In the Figure 2 there are three integration architectures between agents and DBMSs: Layered, Integrated and Built-in. Each one of the three integration architectures has advantages and disadvantages.

Figure 2. Architectures for the integration of Agent Systems and DBMS

The Layered architecture is the one implemented in most of the existing approaches. An information agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through effectors. [9] An information agent is one that does the things like he percepts them, analyzes them and based on these it acts without remembering his history. A question is "how do we measure the efficiency of an agent?" Well it is very hard to make an agent to evaluate his performances. That's why the man is the one who establish a standard of what it means to be successful in an environment and use it to measure the performance of agents. The used architecture puts the agent between user interface and DBMS. Users are represented by their agents in the third layer. The purpose of the agents is to bring to the user individualized information and relevant messages as good as possible. To adapt its owner's information demand the agent collects message specific relevance evaluations given by its owner.[10] The agents communicate through messages and evaluate information giving solutions for the user. In the middle of the system there is an executive agent that has the role to facilitate the communication between agents. It has also the role to evaluate the performances of other agents and to accept or to reject the registration of an agent into the agency.

V. CASE STUDY OF AN AGENT BASED SYSTEM IN WAREHOUSE DATABASES

For this case study we use agent based architecture and tend to adapt it to the market environment. This architecture uses information agents well defined to act and to do specific actions of information management. The particularity of this architecture is the modularity: that means we can add other agents specifying the task first. They extract and offer information in real time which can be used to take advantages to make good decisions. The intelligent systems and especially agent based systems can offer the needed tools for expertise storing in a database management system.[11]

The case study will show that developing an agent based system on information management would be very useful. In a market environment of relationships between products, clients and sellers there is a continuous exchange of information where the main requirement is the guarantee of the high level of service performance.[12]

A. DFD description

In the figure 3. we present the Data Flow Diagram of the agent based system. The system is based on database files which store all the data. The agency is included in the Administration Software.

Each agent needs to perform action to discover changes in its environment. The agents can percept using queries (the action). The DBMS (data software) accesses between agents and database repository.

Through studying stakeholder requirements, we have detected four services which the agents can cover successfully:

- Expertise of selling and inventory (selling agent)
- Display the changes of prizes (display agent)
- Expertise order amounts (order agent)
- Suggestions of prices (price agent)

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

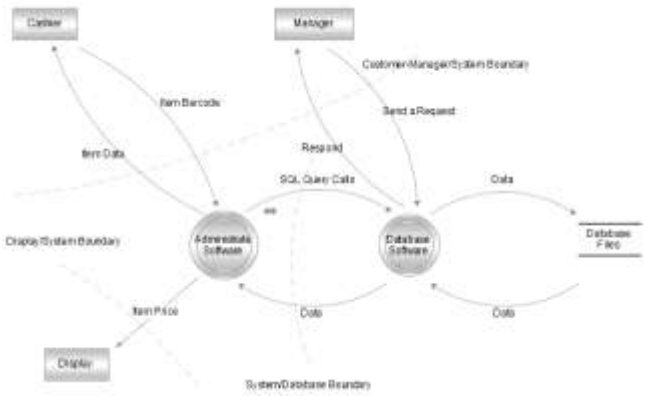


Figure 3. Data Flow Diagram of the agent based system.

We divide the module of Administration Software in these functionalities made by developing four independent agents. Figure 4 shows the data flow inside the system. The manager needs information in two modes: off-line and on-line. Each activated agent gives services and either offers suggestions on prices or makes orders by detecting alert zones for every record, or creates required reports, gives supply solutions, and even shows the points where human service is needed. For example, the visualization agent offers data to distribute in a network of displays taking a map of coordinates for each id_product.

B. The architecture.

In order to save the modularity of the system, we use the layered architecture combined with build in architecture. We think this is the best choice of three architectures in order to develop and integrate new agents without implicating the collection of autonomous agents with a particular expertise. For example we can add a data mining agent. It can use data that is already integrated. There are several actions that must be made before the data gets to the data mining agent. These actions are: data cleaning, data integration, transformation and pattern discovery. We will consider it in the future works.

The algorithm in the figure 4 is used to present one of the agents: price agent. We activate the agent even though it conflicts its definition of the autonomy. The agent acts continuously asking the value of Control_parameter if it is positive or negative. The parameter is calculated by the agent using data gathered from the relevant records. (see formula (1)). The agent can discover its environment in a second manner of perception: action.[13] It sends requests to the DMBS and takes reports from the database for three variables from each record:

1. Daily_average(selling[i])
2. Expiry_date[i]
3. Inventory[i]

The agent offers the new price but it can not decide for a new value confirmed. Here is the end of the agent task and the human operator can ignore or accept the decision of the agent. The system is not completely independent because there are many other factors that classify it as a critical system for the business.

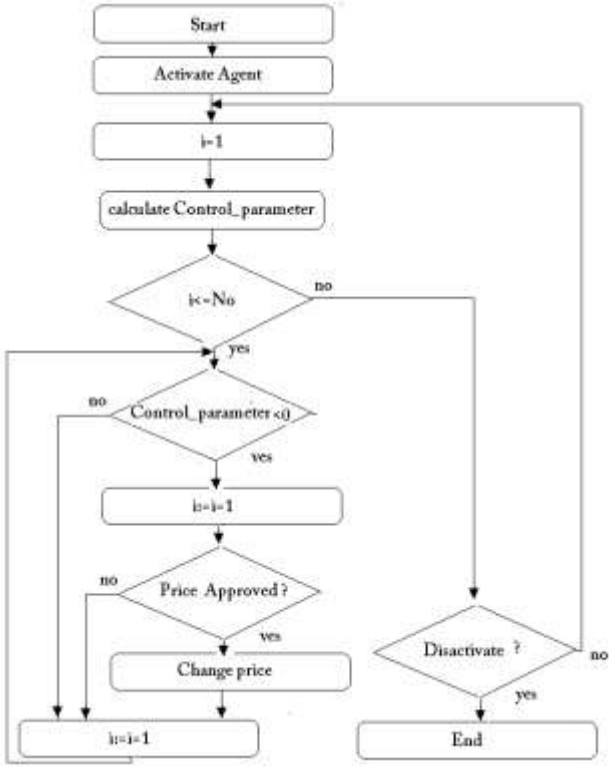


Figure 4. Example of the price agent algorithm

The approach taken gives another agent framework and has a number of advantages coming from the artificial intelligence world and standard object-oriented architectures. The adoption of Java guarantees a widely available, well supported execution environment.

VI. CONCLUSIONS AND FUTURE WORK

At the end of this paper we give some consideration:

- This paper presents a model of database system architecture that implements benefits of using agent techniques and database management system. In the process of studying different architectures, we have chosen the layered architecture in order to raise the level of abstraction.
- We use unique method to develop independent information agents where every agent has a specific task to complete. Agents act independently, nevertheless they can collaborate with users.
- We learned that distribution of functionalities to a database system can be resolved very well using the information agent as an easy way to support database services complexity.
- We have developed four information agents implementing the required functionalities. The results given from the execution of simulation confirm the

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

validity of the model use. We show the simulation in the figure 5.

Figure 5. The view of simulation

- This work is important because it shows that intelligent agents will be the best technologies which will lead to significant improvements in the quality and sophistication of the software systems. The ability of agents to autonomously plan and pursue their actions and goals, to cooperate, coordinate, and negotiate with others, and to respond flexibly and intelligently to dynamic and unpredictable situations will expand their powerful use in many applications.

Our architecture associates one data source with each information agent. This can be easily extended by having other agents increasing the system performance. There are several interesting tracks for future research:

- We aim to implement a new proof of concept, because tool support is essential for the feasibility of the approach. Another similar direction would be to have discovery style retrieval agents. This will also take care of the source failure case, which is not addressed in the current system.
- Our future work will try to extend the modularity of system introducing intelligent agent to complete the goals of the agency, always using one central repository for the standardized, integrated, and validated data.

REFERENCES

[1] Wooldridge, and M., Jennings N. R.,"Intelligent Agents:Theory and Practice", "The Knowledge Engineering Review",vol. 10, no 12, 1995, pp. 115-152,

[2] Weckman, G.R., and Lakshminarayanan, S. "An integrated stock market forecasting model using neural networks", "Int. J. Business Forecasting and Marketing Intelligence", Vol. 1, No. 1, 2008, pp.31-50,

[3] Aparaschivei, F.,"Considerations on Accounting Intelligent Systems Importance", " Informatica Economică", nr. 2 (42),2007, pp.95-100

[4] Boucké, N., and Tom, H., "View composition in multiagent architectures", "Int. J. Agent-Oriented Software Engineering", Vol. 2, No. 1, 2008, pp16.

[5] Weyns, D., Schelfthout, K., Holvoet, T., and Lefever, T., "Decentralized control of E'GV transportation systems"'," ICA A MultiA, Industry Track",July, 2005, pp.25-29.

[6] Lungu, I., Velicanu, M., and Botha, I., "Database Systems – Present and Future", "Informatica Economică", vol. 13, no. 1,2009, pp.84-100,

[7] Wang, Y.K., and Lin Y.H., "Location Aware Information Agent over WAP", "Tamkang Journal of Science and Engineering", Vol. 3, No. 2, 2000, pp. 107-115

[8] Bose,. R., and Sugurnaran, V., "Application of Intelligent Agent Technology for Managerial Data Analysis and Mining", "DBAIS", Vol. 30, No. 1,2003, pp.79-82,

[9] Kalr, G.,and Steiner, D., "Weather Data Warehouse: An Agent-Based Data Warehousing System", "Proceedings of the 38th Hawaii International Conference on System Sciences", 0-7695-2268-8/05 IEEE, 2005, pp.12-16,

[10] Helmer, G.G., Wong, J.S.V., Honavar, and V., Miller, L., "Intelligent Agents for Intrusion Detection", "AMSP of the Ames Laboratory", U. S. Department of Energy, W-7405, 2000, pp.14

[11] Decker, K.S, and Williamson, M."Information Agent Design Notes", "The Robotic Institute", January 30, 1996, pp.14,

[12] Jennings,N.R.,and Wooldridge, M., "Agent technology: foundations, applications, and markets", Springer Verlag, 1998, pp.18-35,

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Determination of the Traveling Speed of a Moving Object of a Video Using Background Extraction and Region Based Segmentation

Md. Shafiul Azam
Lecturer, Dept. of Computer Science and Engineering,
Pabna Science and Technology University, Pabna, Bangladesh.
shahincseru@gmail.com

Md. Rashedul Islam
Senior Lecturer, Dept. of Computer Science and Engineering
Leading University
Sylhet, Bangladesh
rashed.cse@gmail.com

Md. Omar Faruqe
Lecturer, Dept. of Computer Science and Engineering,
Rajshahi University
Rajshahi, Bangladesh
faruqe.cse@gmail.com

***Abstract*—This paper is concerned with the determination of the traveling speed of a moving object of a video clip based on subsequent object detection techniques. After preprocessing of the original image sequence, which is sampled from the video camera, the target moving object is detected with the improved algorithm in which the moving object region can be extracted completely through several processing of background extraction and region based segmentation such as region-connection, region-merging, and region-clustering methods. Among the multiple moving objects of the video, the target object has been detected based on particular criteria of region that it occupies. Then the results of these processing can be used to determine the traveling speed of the target moving object from changes of its coordinate position from the video frames. Among the different video file format, Audio Video Interleaved (AVI) format has been used to examine our experiments.**

Keywords-Background Extraction; Region Based Segmentation;Reference Image, Speed Determination.

I. INTRODUCTION

To determinate the traveling speed of a selected moving object of a video clip, one have to process video clips to get all the frames and also process all the images getting from video clip to extract the object region in each frame in a systematic way. The initial focus of research efforts in this field was on the development of object detection method for detecting the object with certain coordinate position in an image. There are so many techniques for object detection, but no one is efficient for all kind of object as well as, all the object detection techniques is not efficient for the same object in the real world. So still now it has not a final stage that may stop the works in that field. In this paper it is described that Background Extraction and Region Based Segmentation for detect a moving object for determination the traveling speed of that object from a given suitable video sequence. The advantages of these techniques are simplicity, fault tolerance, and efficient for a customized moving object. The key idea of Background Extraction is to extract the static background from the foreground containing some movable image objects that are to be detected. After this, the region based segmentation works as the objects in the image are differentiated by its boundary region and the regions are filled, finally the centered location is find out for identifying that object. Finally the traveling speed of that moving object is determined by calculating the changes its coordinate position in each frame in the video sequence.

II. PROPOSED SPEED DETERMINATION PROCESS

First, The proposed speed determination system of a moving object shown in Fig. 1 consists of processing the video clip, after getting all frame of the video, each frame of the video is processed and find out the coordinate position of each object of the frame and finally determinate the speed of target object from its shifting position . Brief details of each component are described in the following sections.

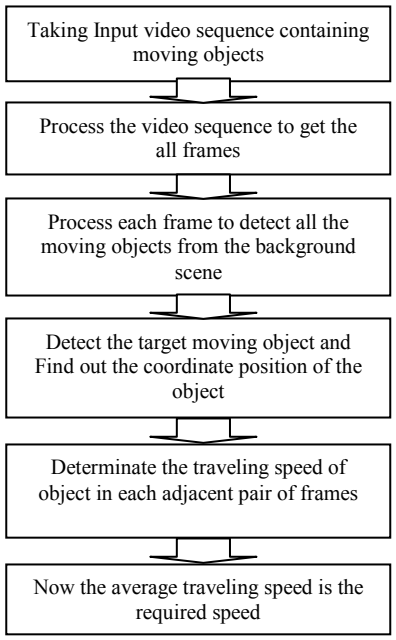


Fig. 1 Schematic diagram of the proposed speed determination of moving object.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

III. INPUT VIDEO PROCESSING

Before you begin to format your paper, first write and save A video signal is a sequence of two dimensional (2D) images projected from a dynamic three dimensional (3D) scene onto the image plane of a video camera. The color value at any point in a video frame records the emitted or reflected light at a particular 3D point in the observed scene. To understand what the color value means physically, we review in this section basics of light physics and describe the attributes that characterize light and its color

Video clip from the video camera is taken and process it as needed to convert AVI format and get all the frames of that video clip which are inputted to the next phase of this work.

IV. DETECTION OF ALL MOVING OBJECTS

Detection of all moving objects is composed of the procedure Background Extraction and Region Based Segmentation which is the most important part of this work and is given bellow:

A. Background Extraction

Define abbreviations and acronyms the first time they are Background extraction is the process of distinguishing novel (foreground) from non-novel (background) elements in a scene from a video sequence [3]. Movement detection would be sufficient to different application. But we can nonetheless specify two characteristics that we would like to find in any algorithm: real time processing and real environment performance.

In this paper, we have used a simple model for extracting background from each frame in the video sequence with respect to a reference image that is given just later.

For detecting object in Speed analysis can be viewed as three different problems [3].

* The first is the case when the camera is moving and the objects in the world are stationary. In this case, the extraction of camera motion is a challenge.

* In the second case, the camera is stationary, and objects in the world are moving.

* It is the combination of the two, where both the camera and some objects in the world are moving.

As, in our work the camera is stationary, so second case is applicable to this point. Different algorithm is usually applied in the second case. In this case, difference algorithm can be divided into two types: one is difference between continuous images; the other is difference between current image and background images. For difference between current image and background image, suppose that the gray value of current image at position (x, y) is f (x, y), the gray value of background image at position (x, y) is b(x, y), the difference between images can be written as:

$$d(x,y) = f(x,y) - b(x,y) \quad (1)$$

For difference between continuous images, suppose that the gray value of image at position (x, y) at time t is f (x, y, t), the gray value of image at position (x, y) at time t+1 is f(x, y, t+1), the difference between images can be written as:

$$d(x,y) = f(x,y,t+1) - b(x,y,t) \quad (2)$$

B. Reference Image

Maximum algorithms for speed detection using background extraction proposed a reference image is need to compare the current image in each frame to detect all the moving objects in the video sequence. In our experiments, in this point of view we have used the still image as the reference image getting from the stationary camera just a few ago of taking the video sequence for the moving objects. This is the most general solution and requires the least amount of computations. For most applications however, the reference image may be updated as the scene might change.

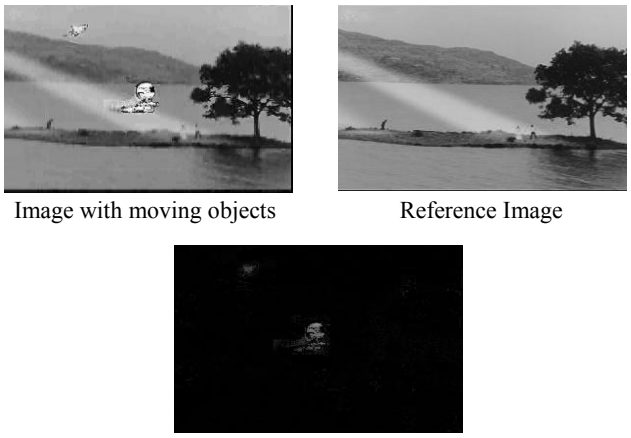


Image with moving objects | Reference Image

Resultant Image of background extraction

Fig 2: Background Extraction

C. Region based segmentation

The objective of segmentation is to partition an image into regions. When a moving object is segmented, a region of pixels assigned to the object is available. This region can be tracked using approaches like cross-correlation. The location of the region in the next frame is to be determined. A moving object usually corresponds to one or several tracked regions. Combination of several regions to one object is then performed at a higher level of abstraction [1].

Basic formulation: Let R represent the entire image region. We may view segmentation as a process that partitions R into n sub regions, R1, R2, R3…..Rn such that

a) $\bigcup_{i=1}^{n} Ri = R$

b) Ri is a connected region,

i=1, 2, 3…….,n.

c) $Ri \cap Rj$ = for all i and j, $i \neq j$.

d) $P(Ri)$ = TRUE for i=1, 2…., n.

e) $P(Ri \cup Rj)$ = FALSE for $i \neq j$.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

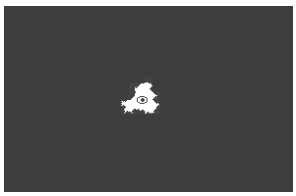
Here $P(Ri)$ is a logical predicate defined over the points in set Ri and Ø is the null set.

V. DETECTION OF THE TARGET OBJECT AND FIND OUT ITS POSITION

To identify a single object as target object with its 2D coordinate position from multiple object in each frame from a video sequence, our algorithm always detect the object that is occupied the maximum region. So, when we will take the video sequence for speed determination of the target object, we will focus on the target object as much as possible that the object will occupy maximum region compared to the other moving object. And of course the camera must static. To identify the position of the target object in each frame of input video sequence the centered point of the total region that is occupied by the object have been considered as reference point.

Improved Image with multiple objects

Improved Image with target object



Improved Image with indicating centered location of Object

Fig 4: Target object detection

In the similar way, the reference point of target object in each frame of the video is find out and stores these positions. Finally from these positions, the movement of target object is measured and the traveling speed is calculated according to the speed calculation procedure.

A. Procedure for object detection

1 for i=0 to (totalFrame-1) do
   a. Read frame[i],
   b. take the reference image, rImg,
   c. Update frame[i] using Extract background by rImg,
   d. process frame[i] as follows :
      i. Determine the connected components.
         1. Run-length encodes the input image.
         2. Scan the runs, assigning preliminary labels and recording label equivalences in a local equivalence table.
         3. Resolve the equivalence classes. Relabel the runs based on the resolved equivalence classes.
      ii. Compute the area of each component.
      iii. Remove small objects bellow a threshold.
   e. Create morphological structuring element, i.e.; Assign the structuring element as follows:

$$\begin{bmatrix} 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 \end{bmatrix}$$

   f. Close the binary image by the structuring element.
   g. Measure image regions
   h. Find the maximum region
   i. Identify the centered location (x , y) of that region.
   j. Return x-coordinate value and y-coordinate value.
   k. End.

VI. DETERMINATION OF THE TRAVELING SPEED OF A SELECTED MOVING OBJECT

Several methods for speed determination of some customized moving object from video sequence have developed to date. All of the methods required to detect the image object due to the positional shift in each frame in the given video clip. In our work our proposed method is quite simple and efficient to determinate the traveling speed of the moving object from video sequence. In this method, firstly, we need to detect the target object that moves from initial frame to the last frame in the given video clip that has already been discussed above.

A sample traveling path of a target object and its coordinate position is shown bellow:

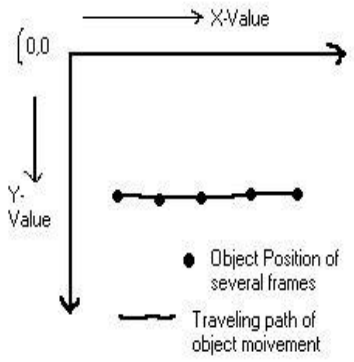


Figure 5: Sample traveling path of a moving object

Our algorithm will work for traveling of object in case of straight line path as well as curvature path approximately. The speed of a moving object is defined as the total amount of distance traveling in unit time.

A. A. Mathematical evaluation for traveling speed determination

Let $f_1, f_2, \ldots\ldots\ldots, f_{n-1}$, are the n frames getting from the processed input video sequence, Then we process the each

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

images with background extraction and region based segmentation technique to detect the moving object that change their own coordinate position in each frame and find out the target object according to their region that it occupies. If the initial position of the target object in first frame f_0 is (x_0, y_0) at time t_0 , the next shifted position in the Second frame f_1 is (x_1, y_1) at time t_1 , then the speed between two points is given by

$$S_0 = \sqrt{((x_0 - x_1)^2 + (y_0 - y_1)^2)} / \Delta t_0 \quad \text{---------(3)}$$

Where, $\Delta t_0 = t_1 - t_0$

In that way, the next speed between the point (x_1, y_1) and (x_2, y_2) is given by

$$S_1 = (\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}) / \Delta t_1 \quad \text{----------(4)}$$

Where, $\Delta t_1 = t_2 - t_1$

In the similar way $S_2, S_3, \ldots\ldots, S_{n-2}$ are calculated.

Now the average speed is the final speed of the target object and is given by:

$$S = S_0 + S_1 + \ldots\ldots\ldots\ldots + S_{n-2}) / (n-1)$$

The value of S is the required speed of the target object in pixel per unit time. The real speed is find out by comparing the pixel with the distance from the left to right point of the scene of a video frame and it is predefined for a specific camera (as the camera stationary). The real distance capture by camera (widely) is taken either from camera parameter or manually.

B. Procedure for speed determination of a selected moving object

1. Load the input video file containing moving objects.
2. Process the file to get the required information about the video file
3. find the number of frames N_F of the video
4. Find the frame rate R_F of the video.
5. Calculate the total duration of the video as: $T \leftarrow N_F / R_F$ second and unit time $\Delta t = T / N_F - 1$
6. Determinate the displacement D_i of the object between the i-th frame and (i+1) -th frame using the Object detection procedure.
7. Calculate the speed S_i between the frames F_i and F_{i+1} as $S_i = D_i / \Delta t$
8. Repeat step 6 to 7 for i= 0 to $N_F - 2$, to determinate all the speed between the frames.
9. Calculate the average value of speed as $S = sum(S_i) / N_F - 1$

   for i= 0 to $N_F - 2$
10. $S_{final} = \frac{TotalDisanCapteredByCameraInMeter(widely)}{TotalPixel(Widely)} \times S$
11. S_{final} is the real speed (meter/ second) of the moving object.
12. End.

VII. RESULTS AND DISCUSSIONS

Firstly, here a sample video clip (first and last frame) which contains a moving object (Ambulance) is shown:

Fig 6: The initial and final stage of a video sample video clip with moving object indication with the circle

Several frames of the sample video (ambulance3.AVI) are given bellow and the coordinate positions of the moving target object are also mentioned with improved frames:

Frame No: 1, Object position (152,92)

Frame No: 7, Object position (132, 93)

Frame No: 13,Object position (112,93)

Frame No: 20,Object position (89,95)

Fig 7: Several frame of input video

Finally, according to the speed calculation procedure, the traveling speed of the moving object of the sample video (ambulance3.avi) is 9.55402 meters per second.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

VIII. CONCLUSION

In this paper, an attempt has been made to develop a virtual system for determination the traveling speed of a selectable moving object of a suitable video clip using subsequent object detection technique based on background extraction and region based segmentation near to the real time. Background extraction and the region based segmentation techniques are relevant to detect multiple moving object to determinate the traveling speed of target moving object of a video clip. As we know that object detection technique is not completely efficient for all kinds of objects which is available presently allover the world, so this work demonstrated some gateway to overcome those limitations. After all, for the test bench for this work, the traveling speed of a selected moving object of a suitable video clip has been determined at a satisfactory level. In this research, the primary works are the video processing as well as image processing for the detection of moving object within the video clip, but it focuses on the detection of multiple objects from images in the video sequences and detecting the target object based on region that it occupies to determine the traveling speed of the moving object.

IX. REFERENCES

[1] Gonzaleg, R.C. Woods, R.E [1992]. 'Digital Image Processing"

[2] Jain,A.K [1989]. "Fundamentals of Digital Image Processing" Prentic-Hall, Englewood Cliffs, N.J.

[3] Yong Fan1, Zhengyu Zhang2, "Journal of Communication and Computer, ISSN1548-7709, USA" Jul. 2006, Volume, No.7 (Serial No.20)

[4] Gonzaleg, R.C. Woods, R.E]. 'Digital Image Processing using Matlab"

[5] Jake K. Aggarwal and Quin Cai. Human motion analysis: a review. Computer Vision and Image Understanding, 73(3):364–356, 1999

[6] Murat Tekalp, Digital Video Processing, Tsinghua University Press and Prentice Hall, Beijing, 1998.

[7] Shuan Wang, Haizhou Ai, Kezhong He, Difference-image-based Multiple Motion Targets Detection and Tracking, Journal of Image and Graphics, Vol. 4, No. 6(A), Jun., 1999: pp. 270-273.

[8] Shuan Wang, Haizhou Ai, Kezhong He, Difference-image-based Multiple Motion Targets Detection and Tracking, Journal of Communication and Computer, ISSN1548-7709, USA, Vol. 4, No. 6(A), Jun., 1999: pp. 270-273.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

An introduction to Biometrics

Sarah BENZIANE,
Institut of maintenance and industrial security,
University of Oran, Algeria
Benziane.sarah@univ-oran.dz

Abdelkader BENYETTOU
Department of Computer Science, Faculty of Science,
University of Science & Technology Mohamed
Boudiaf of Oran, Algeria

***Abstract*— Biometric recognition has been studied over10 years, the biometric use was only limited for the police application's before .During this period, many different problems to the recognition were addressed; when looking to its potential advantages, this technology is now considered for a very great number of other applications. This paper gives an overview of different research on biometrics**

Keywords-component; biometrics; modalities; biometric system; databases

I. INTRODUCTION *(HEADING 1)*

The biometrics word has a large meaning in the study of identification's persons from a number of characteristics. A complex human inheritance, very rich in combinations, and perfectly adapted to such systems of user identification, and/or authentification [1] [2]. It's a Mathematical analysis of biological characteristics of a person to determine his identity decisively. Biometrics based on the principle of some characteristics recognition's. Fingerprints, face, iris, retina, hand, keystroke [3] [4] and voice, provide irrefutable proof of the identity of a person they are unique biological characteristics distinguishing one person from another.

Both identification and authentification differentiate the definition of the biometrics:

- Identification: The confirmation of the identity of the individual which is identity papers or automatic teller machines.
- Authentication: Identification of an individual from a quantity of biometric recorded people. This type of biometric recognition is especially used in the high fields with low number of users or ends of police investigation

II. HISTORY

From some studies, we learn that prehistoric man used his fingerprint to sign in commercial exchanges in Babylone. So why not us? In 1892, Argentine police identified for the first time, a criminal by his fingerprints. Moreover, we can say that the dady of the biometry is Bertillon with its sheets of anthropometric, the inventor of the scientific police. History may say that biometry is very old technique. Although, the first automatic fingerprint prototype came in the mid-1970s, and the first commercial products was marketed in the early 1980s. These systems will be used as a first step for biometric access control and / or time management for clients such as "governmental organization" (eg prisons).

III. WHY BIOMETRICS?

It is pointed out that one of the problems to which we are confronted is the fact that the security of our systems isn't very competent [5]. However, for some applications we need to use password to ease to this security. According to [6] the biometry aim's are based principally on two concepts: the convenience and the security.

Convenience associated to Passwords like code PINE, password PC, credit cards, identity cards, or then keys can be forgotten, lost, stolen and copied. In addition, today everyone should remember multiple passwords and have in their possession a large number of cards. A recent study showed that on standard, an individual uses about 13 passwords in his everyday life. These passwords are sometimes difficult to memorize and are rather often communicated to thirds. The biometry is able to mitigate this problem, and too facilitate the usage as that there will be no password to remember.

In Security [7], the biometry would give us accurate identification without identification papers that may be counterfeit. Also, it would improve the security of protected documents in order to limit fraud. Adapted to the Internet [8], biometrics makes it possible to filter access to sites and intranets. Biometrics can be an ally of privacy to safeguard our identity and integrity of data. But taking into account certain aspects of the protection of this data as shown in [9].

IV. BIOMETRIC SYSTEM

Biometric system's design ensures high reliability and speed of biometrical identification even when using large databases. Based on the principle that such intelligent machine "would tend to build up models from its own databasis within itself and then attempts to identify/authentify each pattern presented"; Capture Identification/Authentification Access [10].

Most of the systems have a common operating technique, which is:

1. Capture

From a sensor system, we capture an image or other signals; which will be analyzed by software processing to identify all the according biometrics characteristics (BC) and miniaturize

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

them (MBC). Which will represent the biometric key of the person, you'll find more explanation in [11] about how to generate this keys.

2. Codification

From this MBC an algorithm codification will be used to increase the degree of security. Nowadays, when speaking about biometry; systematically is joined the word cryptology [12]. The main problem remaining is how to get an efficient system not only in time and rate of identification but too in security of the databases enrollment.

3. Enrollment

Before use, it is necessary to enroll users in advance; to register their biometrics to be used as a template for future use [13]. However, when some privacy aren't respected, some risks appear like the sensitive information about people, the initial templates before codification, identifiers can be forged. This problem received recently a lot of attention. [14] explains the possibility of template protecting biometric authentication systems applied to the fingerprint data.

4. Comparison

This will compare two MBC. It is performed by the biometric algorithm. The algorithm will interpret the 2 MBC to compare and determine if this is the same person. Unlike traditional passwords, it is not a comparison of 2 zones. This decision is taken automatically by a complex algorithm after decryption and interpretation of the 2 MBC.

5. Authentification

By the mean verification of the identity, more called "one against one" based on protection templates [14]. When verification of an identity, we begin by stating his identity (original name, id ...), then presents the appropriate biometrics to the system, built the software then waiting MBC. It only remains to verify that the stored MBC and MBC pending are the same: if so, the person is that it claims to be!

But storing the MBC is a problem, because this information can be pirated and stolen. So, if the biometric data were not stored, they would be more difficult to steal. It would be also more difficult to compromise a great number of it simultaneously [15]. To mitigate this problem, [16] proposes a biometric diagram of authentification not requiring the comparison with a reference since it doesn't require storage. Many works has been dedicated to this context; [17] [18] .

6. Identification

Called too, comparison "one against n", this operation is to find someone in a group by means of its biometric key. This time no reference is given, pending the MBC is then compared to all MBC previously recorded in the database.

V. How to know if biometric system is accurate?

We measure the performance of a biometric system by two error rate: the FRR (false reject rate) and FAR (false acceptance rate). The FRR relates to the probability that a biometric system fails in the authentication of a registered person and the FAR refers to the probability of an incorrect verification.

A third parameter (FER) measures the failure rate for enrollment. It reflects the probability of absence of a biometric feature for an individual in a population.

VI. Biometric modality

The biometric applications are now all around us in the travel, transportation, border control, homeland security, healthcare, banking and finance, access control, airport security, law enforcement, automotive, cyber security, encryption, nuclear power plants [19] and watermarking. Essentially, we can differentiate three modalities concept:

I. PROCESSING BASED ON MORPHOLOGICAL ANALYSIS:

- FINGERPRINT

Is the largest biometric application technology used in automated fingerprint identification systems. The fingerprint are the unique individual characteristics, that is more than 100 years under the fingerprinting is known because the probability is less than 1 to one billion indicated that two models have identical fingerprints. Many programs was made to reach a such application within them: FpVTE, Propriety Fingerprint Template (PFT), Slap fingerprint segmentation evaluation ,Fast fingerprint slap capture ,Fast rolled equivalent fingerprint capture ,Latent fingerprint testing (NIST), Fingerprint minutiae interoperability testing.

To identify directly a fingerprint within many known fingerprints patterns [20] is not an easy task owing rough fingers, damaged fingerprint areas or the different orientation or deformation of the fingerprint during the scan. [21] Highlight the time identification mainly. Technically two solutions are applied in image processing for the detection:

- Minutiae's points localization [22]
- Texture analysis [23]
- And sometimes matching the two features [24][9][25]

It's possible to find some platforms related on the market: VeriFinger Software Development Kit, FingerCell Embedded Development Kit, MegaMatcher software Development Kit.

It has as advantages Low cost and minimal obstruction but requires a clean environment. Some of its main suppliers are Identix, Dermalog, Cross Match, Polaroid, Veridicom, Digital Persona, Sagem Morpho, Sonda, Cogent Systems, ActivCard (Ankari).

- FACE

One of the most interesting and promising methods contactless biometric identification is the automatic detection of faces. Recently technical realization of these detection

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

systems are based, on the computing of neuronal calculation procedure [26] [27]. [28] proposed a fusion method based on Support Vector Classifier with combination of two different face experts. The facial recognition is being very used for the physical access control and computer user accounts security.

Historically, one of the first works made on are those of Chernoff about the seventies [29]. Starting from works of Professor Teuvo Kohonen [30], researcher in neural networks of the University of Helsinki, and work of Kirby and Sirovich [31] of the Brown University of Rhode Island, was developed by MIT the first face recognition system named eigenface.

Generally, the detection [32] [33] is made by the extraction of some measurable features from the face images, as shape and texture[34].[35] shows that' possible ti use the sift operator for face verification, the most are used for the fingerprint feature extraction and matching .The main problem met is the illumination scene [36][37]; [38] proposes to use the photometric normalization as a pre-processing face algorithm. Many works have been developed in this way [39], although the detection's technique used depends essentially of the support technology, the main exploited is the smartcard [40]. [41] presents an experimental approach; based on the similarity measure between pairs of images which are computed based on the mean Manhattan difference between corresponding histograms .[42] uses GMM (Gaussian Mixture Model) classifier in the face authentification for instance .Somehow, [43] explains virtual samples in machine learning, and by the way how a model can be built from chimeric database .Whithin the baseline experiments, we can quotes two of them: the based on DCTmod2 feature extraction [44], and those based on normalized face images and RGB histograms [45].It tends actually to be used with other biometric technologies for security-critical applications. Emotion recognition [46] is an example of a lot of research works that can be used in communication with the computer and other hardwares.

Many International programs were made to reach such application within them: Face recognition vendor Tests, Face recognition grand challenge. It's possible to find some platforms related on the market; VeriLook SDK, FaceCell EDK, MegaMatcher SDK.

Its main advantage is the Simplicity and the efficiency on a flow of people, although it requires a rigorous implementation. This technique can perfectly be associated to monitoring video system.

- EYE

Both the fingerprint pattern and the eye pattern are unique for an individual. Better than the fingerprint recognition the iris doesn't change with along years or other parameters as for the fingers. The retina scans, is done at a distance of a near-infrared spectral region. Products based on have been available commercially since 1985. The technology development and evaluation methodology for face recognition was based on the FRVT2006, the FRGC and The iris challenge evaluation ICE program [47].

One of the technologies used for this pattern based on neural networks and presenting a great performance is the VeriEye SDK by Neurotechnology.

In this modal, we can distinguish two large contexts the retina and the iris. For the extraction of the pupil from the iris much works can be listed [48] [49]. Therefore, the pioneer in the iris recognition is J.DAUGMAN, his first publication was [50] using the Gabor wavelets. Which was improved after by several others as [51][52][53].It presents an excellent reliability, low reject rate but the hardware used is expensive and needs some requirements on lighting [54]. To know more about how to identify a person from its iris pattern, we recommend you to read [55].

- SPEECH

In 1962, Lawrence Kersta, an engineer of Bell Laboratories, establishes that the voice of each person is single and that it is possible to represent it graphically, the voice consists of physiological and behavioral components. Actually, used by the police, the espionage agencies, the immigration services, the hospitals and in telephony.

Voice verification is a very attractive biometric approach because of its acceptability to users. The data used by the voice recognition come at the same time from physiological and behavioral factors. But unfortunately they are in generally imitable.

We'll not, detail more about the speech recognition we direct the readers to BIOM. The technology is such as now; we can recognize a person from his mobile phone [56], and it's very easy to implement it. [57]

Some of its suppliers; IPI speech technologies, VeriVoice, Veritel, T-Netix, OTG, Nuance, Keyware, Graphco Technologies, Anovea and Voicevault.

To more detail [58] [59][60] presents excellent solutions to many of the critical problems of the speech identification biometric as: the variability due to the speaker (emotion, tiredness, stress), the variable conditions of recording (microphones, ambient noise [RIC06] using the toolkit ALZE [61]), the variable conditions of transmission (voice channel) and some new problems as for the GSM: coding, noise evolving/moving in the time. A lot of features can be used, we can distinguich whtihin them : the PAC (Phase Auto Correlation) [62], SSC (Spectral Subband Centroid) [63] and the LFCC (Linear Filter-bank Cepstral Coefficient)[64]. More details on features speaker verification can be found in [65] .

- HAND

Hand geometry is the granddaddy of biometrics by asset of a 20-year history of live applications. This type of biometric measurement is one of widespread, particularly in the United States. That consists in measuring several hand characteristics (the shape of the hand [66], length and width of the fingers, the shapes of the articulations, lengths inter-articulations, and veins). There have been six different hand-scanning products

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

developed over this span, including the most commercially successful biometric to date, the ID-3D Handkey from Recognition Systems, Inc.

The hand geometry identification is principally based on feature extraction; in the literature, there are too much different techniques with different characteristics [67]used for the hand geometry identification (b-spline [68], general regression neural networks [69], implicit polynomials [70]). [71] presented an evaluation of the verification system performance taking into account 17 hand geometrical features.

As for the fingerprint recognition the extraction of the features is very difficult, which needs several consecutives steps: Segmentation hand, illumination hand correcting image (removing rings or tatous), texture enhancement [72], determination of finger tips and valleys, translation and rotation of the hand to get finally the right pattern to compare. [73] proposes an online personal identification using palmprint [74] technology employing low-resolution palmprint images to achieve effective personal identification based on some past works which have gave good results [75][76][77][78]. [79] proved that it's possible too to use an active shape structural model (ASSM) based on deformable shape model[80] to identify templates of different users with a high accuracy .Some authors inspired from hand gesture recognition works [81][82]; which the new technology by the mean of a touch-less biometrics [83]. Although, [84] a wavelet decomposition method is presented improving wavelet analysis of the hand centroid signals for detecting hand motion. While, [85] proposed to match between hand geometry and palmprints to improve in retrieval time the identification accuracy .It is not the simplest biometrics of use but it is considered by the users as a non-intrusive. However the hardware used presents a high obstruction, and the hands can changes over time; some of the main suppliers are Recognition Systems Inc. (RSI), Dermalog, Biomet Partner (just two fingers), Stromberg.

2. THE EXAMINATION OF BIOLOGICAL EVIDENCE

- EMERGENT TECHNOLOGIES

Based on the EEG Features extraction [86][87] , suggest a fast and unremarkable authentication method that only uses 2 frontal electrodes referenced to another one placed at the ear lobe, i.e. an encephalogram [88]. It isn't an easy method to identify a person but it can be used for some applications. This biometrics is new and not very well-known and used, but many works are made in [89] [90] [91] [92].

We can quote too, the vein scan from captured images of blood vessel patterns, which is commercially available. The Facial thermography using an infrared camera for detection of heat patters generated by the blood vessels branching and produced from the skin; the implementation is very expensive which don't lead its first commercialization to fail. Then, the famous DNA comparing increase samples with templates generated from samples; and may be the oldest emergent technology implemented. Too, the odor sensing which capt in the air the chemicals volatile skin pore's emitting; for this technology considering the progress which was made in it will run out many years before seeing in it the market. Also, which is very experimental for the moment is the blood pulse measurement using the infrared sensors on a finger; it is used in hospitals to measure the blood pulse but not yet to identify a person. The main emereging metrics now are first; the skin pattern recognition by distinct optical patters extraction using a spectroscopic measurement of skin light dotted. Second, the nailbed identification using an interferometer to detect phase changes in light shine on the fingernal, it rebuilds distinct dimensions of the nailbed; and finally the ear shape based on distinctive ear shape like for the hand shape recognition.

3. PROCESSING BASED ON BEHAVIORAL ANALYSIS:

- SIGNATURE

This type of biometrics is little used at the present time but not many works are done in this fields and some hopes to rather quickly impose it for specific applications (electronic documents, reports, contracts...). It is considered as an application of the handwriting recognition [93]; so in this context a great number of works has been made. Although, in [94] presented a classification of all the biometric signatures which are used in [95], [96]. Explain more the different biometric signatures and their role within the core process of the biometric authentification systems. The process is usually combined with an electronic paint system (or equivalent) provided with a pen. Although, today the most used database is the BIOMET database. We can distinguish two ways of capturing a signature, either with sensors which are assimilated to simple scanners, or by the use of a graphics tablet and a sensitive pen.

- MULTIMODAL

The multi-biometrical approach facilitates where another biometric feature worst for certain groups of users. The speed and precise identification has been developed for particularly critical applications, such as passport and visa documentation, border crossings, election control systems, credit card transactions control and crime scene investigations. Knowing that a biometric system can never present a rate of efficiency equal to 100%; the multimodal systems or more known as multi-biometrics systems was elaborated; In order to provide a greater performance and reliability. Many biometrics can be matched (face-fingerprint), (face -voice), (Face-Iris) [97], (speech-lip) [98] and sometimes too signature/multimodal [99]. [100] [101] integrates to the videos faces recognition the speech related to. To fusion such metrics, many techniques of fusion were used to as in [102].They, used a particular Bayesian classifier for their context, but in [103] studies this point and get to an new approach on the fusion using a non-trainable COM, that is the mean operator. [104] made in evidence the deals with quality dependent score normalization [105]. [106], for quality enhancement, they proposed discriminative fusion based on reduced polynomial

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

discriminative function. To know more about the fusion in the multi-biometrics, we counsel. Several programs were born from the born of the last technologies within: MGC, MBARK, CITeR

VII. SOME DATABASES

- BIOMET

It was created for "the multimodal biometric identity verification". The purpose of BIOMET was to put together the skills of GET teams Schools involved in the identification and authentication to access a secure system through various ways: authentication of signatures, facial analysis, Fingerprints and shape of the hand, authentication of the speaker and their combination too, for multimodal biometric identity verification [109][110].

- BANCA

Is a novel huge, challenging multi-modal database for training and testing multi-modal verification systems. The BANCA database is made of two modalities [111][112][42] (face and voice). In order to get, both high and low quality microphones and cameras were used. The capture's database is composed of in total 208 people, half men and half women.

- 3. NIST

Is a scientific technical large scale databases for testing [NIS05]; collecting several fields as Analytical Chemistry, Atomic and Molecular Physics, Biotechnology, Chemical and Crystal Structure, Chemical Kinetics, Chemistry, Communications, Construction, Environmental Data, Fire, Fluids, International Trade, Law Enforcement, Materials Properties, Mathematical Databases, Software and Tools, Optical Character Recognition, Physics, Product Design, Surface Data, Text and Video Retrieval, Thermophysical and Thermochemical and within them we quote biometrics. For the biometrics NIST, is a public collection of digital video's fingerprint and mugshot databases in order to make easier research development in the law enforcement field. Through years will administer many evaluations as [113][114] [115]. In their Results we can remark that fingerprints, speaker [116] and face provide similar precision for verification if the image captured quality is well.

So, our paper not focalizing on this point, we have just quoted three of the main used databases, others very used too. As the FERET database [117] uses different faces with variable positions achieving accuracy for a database of only 200 people. The xm2vts database, [118] showed intramodal and multimodal expert fusion. A xm2vts database evaluation of face verification is presented in [119]; And the NOISEX-92 database [120].

We notice too, that there's some open source platform dedicated to the biometric authentification as the MISTRAL, the ALIZE [121]

VIII. CONCLUSION

Now, the components have the power necessary to a processing of this type and their cost does not cease decreasing. Yes, it's possible a kind of this biometrics which change our life's day [122]. Nowadays, in some USA cantina's colleges are dotted of technologies which allow them to identify a hand teenager in spite of the fact that a teenager is in phase of physical changing, without having to carry out catches of repeated measurements along years.

Currently, we're thinking of the future works of this biometrics world's which is leaning towards a contactless biometrics. Researchers are on the development of the veinal recognition which as for the hand morphology that's unique for each person and may not change in time. The veinal recognition could prove in the long term like the means biometric more on [123].

In conclusion, the biometric systems little by little replace the use of passwords, even of keys which were currently used for the computers, the cars, the accesses controlled to buildings or Internet. The systems which meet the most success are those which offer the simplest interface and least constraining to the user, while guaranteeing a good level of safety. Finally, the biometric authentification contributes to make the use of certain systems simpler and more convivial.

REFERENCES

[1] S.A-zubi and K.Tonnies, "Generalizing the active shape model by integrating structural knowledge to recognize Hand Drawn sketches",CAIP2003.

[2] T. Ahonen, A. Hadid, and M. Pietikainen, "Face Recognition with Local Binary Patterns," in Proc. European Conference on Computer Vision, Prague, 2004, pp. 469–481.

[3] S. Bengio and J. Mari´ethoz, "The Expected Performance Curve: a New Assessment Measure for Person Authentication," in The Speaker and Language Recognition Workshop (Odyssey), Toledo, 2004, pp. 279–284.

[4] Frederic Bimbot, Jean-François Bonastre, Corinne Fredouille, Guillaume Gravier, Ivan Magrin-Chagnolleau, Sylvain Meigner, Teva Merlin, Javier Ortega-Garcia, Dijana Petrovska-Delacretaz et Douglas A. Reynolds. " A tutorial on text-independent speaker verification", EURASIP Journal on Applied Signal, 2004, Processing, 4:430451.

[5] J.-F. Bonastre, F. Wils, and S. Meignier, "ALIZE, a free toolkit for speaker recognition," in Proc. 2005 IEEE International Conference on Speech, Acoustics and Signal Processing, pp. 73 740, (Philadelphia), 2005.

[6] Arslan Bromme, "A discussion on privacy needs and (MIS) use of biometric IT systems", IFIP WG 9.7/11.7 SCITS-II Bratislava, Slovakia, 2001.

[7] Arslan Bromme. "A classification of biometric signatures", IEEE ICME 2003 Baltimore, MD, USA, JULY 6-9 2003.

[8] Buhan and P. Hartel, "The State of the Art in Abuse of Biometrics," Centre for Telematics and Information Technology, University of Twente, Technical Report TR-CTIT-05-41,December 2005

[9] F. Cardinaux, C. Sanderson, and S. Marcel, "Comparison of MLP and GMM Classifiers for Face Verification on XM2VTS," in 4th Int'l Conf. Audio- and Video-Based Biometric Person Authentication (AVBPA'03), Guildford, 2003, pp. 911–920.

[10] F. Cardinaux, C. Sanderson, and S. Bengio, "User Authentication via Adapted Statistical Models of Face Images," IEEE Trans. on Signal Processing, vol. 54, no. 1, pp. 361–373, January 2006.

[11] Cenker Oden, Aytul Erc¸il, Vedat Taylan Yildiz, Hikmet Kirmizitas, and Burak Buke, "Hand recognition using implicit polynomials and geometric features". In Josef Bigun and Fabrizio Smeraldi, editors, Proceedings of the Third International Conference on Audio- and Video-

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Based Biometric Person Authentication, volume 2091 of Lecture Notes in Computer Science, pages 336–341. Springer, June 2001.

[12] U.V. Chaudhari, J. Navratil, G.N. Ramaswamy, R.D. Zilca, "Future speaker recognition systems: Challenges and solutions" Proceedings of AUTOID-2002, Tarrytown, NY, March 2002.

[13] C. K. Chang, "Human identification using one lead ECG," M.S. thesis, Department of computer science and information engineering. chaoyang university of technology, Taiwan, 2005.

[14] Cherno , H., "The use of Faces to Represent Points in k-Dimensional Space Graphically", Journal of the American Statistical Association, 68, 361-368, 1973.

[15] S.I. Choi, C.K. Kim, C. Choi, "Shadow compensation in 2D images for face recognition, Pattern Recognition" 40 (2007) 2118 – 2125

[16] T. Charles Clancy, Negar Kiyavash, and Dennis J. Lin, "Secure smartcard based fingerprint authentication", In Workshop on Biometrics Methods and Applications, pages 45–52, New York, NY, USA, 2003. ACM Press.

[17] B. Cukic and N. Bartlow, "Biometric System Threats and Countermeasures: A Risk Based Approach," in Proceedings of Biometric Consortium Conference (BCC), Crystal City, USA, September 2005.

[18] J Czyz, M Sadeghi, J Kittler, and L Vandendorpe, " Decision fusion for face authentication". In First International Conference on Biometric Authentication, 2004.

[19] S. Dass, K. Nandakumar, and A. Jain, "A Principled Approach to Score Level Fusion in Multimodal Biometric Systems," in 5th Int'l. Conf. Audio- and Video-Based Biometric Person Authentication (AVBPA 2005), New York, 2005, pp. 1049 1058.

[20] S.C. Dass, Y. Zhu, and A. K. Jain, "Validating a biometric authentication system: Sample size requirements," IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 28, no. 12, pp. 1302–1319, 2006.

[21] Daugman J and Downing C, "Epigenetic randomness, complexity, and singularity of human iris patterns", Proceedings of the Royal Society, B, 268, Biological Sciences, pp 1737 - 1740. 2001

[22] Daugman J., "The importance of being random: Statistical principles of iris recognition. Pattern Recognition", vol. 36, no. 2, pp 279-291. 2003

[23] Daugman J., "Probing the uniqueness and randomness of IrisCodes: Results from 200 billion iris pair comparisons", Proceedings of the IEEE, vol. 94, no. 11, pp 1927-1935. 2006

[24] J.DAUGMAN, "High confidence recognition of persons by rapid video analysis of iris texture". In European Convention on security and detection. May 1995. PP.244-251

[25] David Zhang, Wai-Kin Kong, Jane You, and Michael Wong. "Online Palmprint Identification", ieee transactions on pattern analysis and machine intelligence, vol. 25, no. 9, september 2003

[26] K. Delac and M. Grgic, "A survey of biometric recognition methods", Electronics in Marine, 2004, Proceedings Elmar 2004, 46th International Symposium, pp 184-193 (2004).

[27] G. Doddington, W. Liggett, A. Martin, M. Przybocki, and D. Reynolds. Sheep, Goats, Lambs and Woves, " A Statistical Analysis of Speaker Performance in the NIST 1998 Speaker Recognition Evaluation", In Int'l Conf. Spoken Language Processing (ICSLP), Sydney, 1998.

[28] Yevgeniy Dodis, Leonid Reyzin, and Adam Smith, "Fuzzy extractors : How to generate strong keys from biometrics and other noisy data", In EUROCRYPT, pages 523–540, 2004.

[29] Jean-Luc Dugelay, "Biometrics and multimedia 2nd ECRYPT Summer School on Multimedia Security", 24-27 September 2007, Thessaloniki, Greece

[30] N. Duta, A.K. Jain, and K.V. Mardia, "Matching of Palmprint," Pattern Recognition Letters, vol. 23, no. 4, pp. 477-485, 2001.

[31] Erdem Yörük, Ender Konuko˘glu, Bülent Sankur, "Shape-Based Hand Recognition," in IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 15, NO. 7, JULY 2006

[32] S. Furui, "Recent Advances in Speaker Recognition", Pattern Recognition Letters, Vol. 18, No. 9, 1997, pp. 859-872.

[33] G.K. Ong Michael et al., "Touch-less palm print biometrics: Novel design and implementation", Image Vis. Comput. (2008), doi:10.1016/j.imavis.2008.06.010

[34] Golfarelli, M., Maio, D., & Malton, D. (1997). "On the error-reject tradeoff in biometric verification systems", Pattern Analysis and Machine Intelligence, IEEE Transactions, 19(7), 786–796.

[35] Gross, R., Brajovic, V., "An image preprocessing algorithm for illumination invariant face recognition", In: 4th Int'l Conf. Audio and Video-Based Biometric Person Authentication (AVBPA'03). (2003) 10–18

[36] C.C. Han, H.L. Cheng, K.C. Fan, and C.L. Lin, "Personal Authentication Using Palmprint Features," Pattern Recognition, Special Issue: Biometrics, vol. 36, no. 2, pp. 371-381, 2003.

[37] Pim Tuyls, Anton H.M. Akkermans, Tom A.M. Kevenaar, Geert-Jan Schrijen, Asker M. Bazen, and Raymond N.J. Veldhuis. "Practical Biometric Authentication with Template Protection", Publisher Springer Berlin / Heidelberg , ISSN 0302-9743 (Print) 1611-3349 (Online), Volume 3546/2005, Book Audio- and Video-Based Biometric Person Authentication, 2005, ISBN 978-3-540-27887-0, DOI 10.1007/11527923_45, Pages 436-446.

[38] M.A. Hussain, "Automatic recognition of sign language gestures", Master's Thesis, Jordan University of Science and Technology, Irbid, 1999.

[39] S. Ikbal, H. Misra, and H. Bourlard. "Phase Auto-Correlation (PAC) derived Robust Speech Features", In Proc. IEEE Int'l Conf. Acoustics, Speech, and Signal Processing (ICASSP-03), pages 133{136, Hong Kong, 2003.

[40] A. Jain, A. R., "Fingerprint matching using minutiae and texture features", hessaloniki, Greece, October 2001, In Proc. of International Conference on Image Processing (ICIP), pages , 282–285,.

[41] A.K. Jain, A.Ross, S.Pankanti. "Biometrics: a tool for Information security", IEEE Transactions on information Forensisc and security 1 (5), (pp. 153-132) june 2005.

[42] A.K. Jain and R. Bolle and S. Pankanti, "Biometrics: Person Identification in Networked Society", Kluwer Publications, 1999.

[43] Kirby, Sirovich, "Application of the karhunen-loeve procedure for the characterization of human faces", IEEE Pattern Analysis and Machine Intelligence, vol. 12, no. 1, 1990.

[44] D. R. Kisku, A. Rattani, E. Grosso, and M. Tistarelli, "Face Identification by SIFT based Complete Graph Topology", Automatic Identification Advanced Technologies, 63 68, 2007.

[45] J. Kittler, K. Messer, and J. Czyz., "Fusion of Intramodal and Multimodal Experts in Personal Identity Authentication Systems", In Proc. Cost 275 Workshop, pages 17{24, Rome, 2002.

[46] Teuvo Kohonen, "Self-organization and Associative Memory", Springer-Verlag, Berlin, 1989.

[47] A. Kumar, D. C. Wong, H. C. Shen, and A. K. Jain, "Personal verification using palmprint and hand geometry biometric," presented at the 4th Int. Conf. Audio- andVideo-based Biometric Person Authentication, Guildford, U.K., June 9–11, 2003.

[48] Kumar, A., & Zhang, D., (2004), " Integrating shape and texture for hand verification", Image and graphics, In Proceedings of the third international conference on 18–20 December 2004, (pp. 222–225).

[49] [51] [KUN02] L.I. Kuncheva, "A theorical study on six classifier fusion strategies. In IEEE Transaction on Pattern Analysis and Machine Intelligence. February 2002, vol. 24, pp. 281-286. 7

[50] S. Marcel and S. Bengio, "Improving Face Verification Using Skin Color Information," in Proc. 16th Int. Conf. on Pattern Recognition, Quebec, 2002.

[51] Johnny Mariethoz and Samy Bengio, "A Bayesian Framework for Score Normalization Techniques Applied to Text Independent Speaker Verification", IEEE Signal Processing Letters, 12(7):532–535, 2005.

[52] Sébastien Marcel, José del R. Millan, "Person Authentication Using Brainwaves (EEG) and Maximum A Posteriori Model Adaptation," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 29, no. 4, pp. 743-752, Apr., 2007

[53] frédéric massicotte, « la biométrie, sa fiabilité et ses impacts sur la pratique de la démocratie libérale », maîtrise en science politique, université du québec à montréal, 2007.

[54] J. Matas, M. Hamouz, K. Jonsson, J. Kittler, Y. Li, C. Kotropoulos, A. Tefas, I. Pitas, T. Tan, H. Yan, F. Smeraldi, J. Begun, N. Capdevielle, W. Gerstner, S. Ben-Yacoub, Y. Abdeljaoued, and E. Mayoraz, "Comparison of Face Verification Results on the XM2VTS Database", In Proc. 15th Int'l Conf. Pattern Recognition, volume 4, pages 858{863, Barcelona, 2000.

[55] E. Bailly-Bailliere, S. Bengio, F. Bimbot, M. Hamouz, J. Kittler, J. Mariethoz, J. Matas, K. Messer, V. Popovici, F. Poree, B. Ruiz, and J. P. Thiran. "The BANCA database and evaluation protocol", In Audio- and

Video-Based Biometric Person Authentication: Proceedings of the 4th International Conference, AVBPA 2003, volume 2688 of Lecture Notes in Computer Science, pages 625–638, Berlin, Germany, June 2003. Springer-Verlag.

[56] T. Matsumoto, M. Hirabayashi, and K. Sato, "A Vulnerability Evaluation of Iris Matching (Part 3)," in Proceedings of the 2004 Symposium on Cryptography and Information Security, Iwate, Japan, January 2004, pp. 701–706.

[57] Federico Matta, Jean-Luc Dugelay, « Introduction de paramètres dynamiques en reconnaissance faciale CORESA 2007 », 12èmes journées d'étude et d'échange COmpression et REprésentation des Signaux Audiovisuels, November 8-9 2007, Montpellier,France

[58] Federico Matta, Jean-Luc Dugelay, "Tomofaces: eigenfaces extended to videos of speakers" ICASSP 2008, IEEE International Conférence on Acoustics, Speech, and Signal Processing, March 30 - April 4, 2008, Las Vegas, Nevada, USA

[59] Melin, H., "Automatic Speaker Verification On Site and by Telephone: Methods, Applications and Assessment", Doctoral Thesis, Department of Speech, Music and Hearing, KTH, 2006.

[60] K. Messer, J. Kittler, M. Sadeghi, M. Hamouz, A. Kostyn, S. Marcel, S. Bengio, F. Cardinaux, C. Sander-son, N. Poh, Y. Rodriguez, K. Kryszczuk, J. Czyz, L. Vandendorpe, J. Ng, H. Cheung, and B. Tang. "Faceauthentication competition on the BANCA database", In Proceedings of the International Conference onBiometric Authentication (ICBA), Hong Kong, July 15 17 2004

[61] G. Mohammadi, P. Shoushtari, B. Ardekani, and M. Shamsollahi, "Person identification by using AR model for EEG signals," in Proceedings of the 9th International Conference on Bioengineering Technology (ICBT '06), p. 5, Czech Republic, 2006.

[62] NIST, "The 2005 NIST Speaker Recognition Evaluation," 2005, [Available at http://www.itl.nist.gov/iad/894.01/tests/s k/2005/]

[63] Ovunc¸ Polat , Tulay Yıldırım, "Hand geometry identification without feature extraction by general regression neural network", Expert Systems with Applications 34, 2008 (pp. 845–849)

[64] K. K. Paliwal. "Spectral Subband Centroids Features for Speech Recognition", In Proc. Int. Conf. Acoustics, Speech and Signal Processing (ICASSP), volume 2, pages 617{620, Seattle, 1998.

[65] S. Pankanti, S. Prabhakar, and A. K. Jain, "On the Individuality of Fingerprints," IEEE Transactions on Pattern Analysis and Machine Intelligence 24(8), pp. 1010–1025, 2002

[66] Paranjape, R.B., Mahovsky, J., Benedicenti, L., Koles, Z., 2001, "The electroencephalogram as a biometric", In: Proc. Canadian Conf. on Electrical and Computer Engineering, vol. 2, pp. 1363-1366.

[67] S. Parthasaradhi, R. Derakhshani, L. A. Hornak, and S. A. C. Schuckers, "Time-Series Detection of Perspiration as a Liveness Test in Fingerprint Devices," IEEE Transactions on Systems, Man, and Cybernetics, Part C: Applications and Reviews, vol. 35, no. 3, pp. 335–343, 2005.

[68] P.J.Philips, H.J.Moon, S.A.RIZVI, and P.J.Rauss. "The feret evaluation methodology for face recognition algorithms", IEEE Trans. on Pattern analysis and Machine Learning, vol. 22, no. 10, pp. 1090-1104, October 2000

[69] P. J. Phillips, W. T. Scruggs, A. J. O´ Toole, P. J. Flynn, K. W. Bowyer, C. L. Schott, and M. Sharpe, "FRVT 2006 and ICE 2006 Large-Scale Results," NIST, Technical Report NISTIR 7408, March 2007.

[70] N. Poh, S. Marcel, and S. Bengio, "Improving Face Authetication Using Virtual Samples", In IEEE Int'l Conf. Acoustics, Speech, and Signal Processing, pages 233{236 (Vol. 3), Hong Kong, 2003.

[71] N. Poh and S. Bengio. "Why Do Multi- Stream, Multi-Band and Multi-Modal Approaches Work on Biometric User Authentication Tasks?", In IEEE Int'l Conf. Acoustics, Speech, and Signal Processing (ICASSP), pages vol. V, 893{896, Montreal, 2004.

[72] M. Poulos, M. Rangoussi, N. Alexandris, and A. Evangelou, "On the use of EEG features towards person identification via neural networks," Medical Informatics & the Internet in Medicine, vol. 26, no. 1, pp. 35–48, 2001.

[73] M. Poulos, M Rangoussi, and E. Kafetzopoulos, "Person identification via the EEG using computational geometry algorithms," in Proceedings of the 9th European Signal Processing, (EUSIPCO '98), pp. 2125–2128, Rhodes, Greece, September 1998.

[74] L. Rabiner and B-H Juang, "Fundamentals of Speech Recognition". Oxford University Press, 1993.

[75] Richiardi, J., Prodanov, P., Drygajlo, A., "Speaker verification with confidence and reliability measures". In: Proc. 2006 IEEE International Conference on Speech, Acoustics and Signal Processing, Toulouse, France (2006)

[76] A. Riera, A. Soria-Frisch, M. Caparrini, C. Grau, and G. Ruffini. "Unobtrusive Biometric System Based on Electroencephalogram Analysis", EURASIP Journal on Advances in Signal Processing. Volume 2008, Article ID 143728, 8 pages, October 2007

[77] A. Ross, A. Jain, and J-Z. Qian. "Information Fusion in Biometrics", Pattern Recognition Letter, 24(13):2115{2125, September 2003.

[78] M. Rosenblum, Y. Yacoob, and L. S. Davis. "Human emotion recognition from motion using a radial basis function network architecture", In IEEE Workshop on Motion of Non-Rigid and Articulated Objects, pages 43{49, 1994.

[79] Henry A. Rowley, Shumeet Baluja, and Takeo Kanade, "Neural Network-Based Face Detection", 1998 IEEE

[80] Henry A. Rowley, "Neural Network-Based Face Detection", partial fulfillment of the requirements for the degree of Doctor of Philosophy. Computer Science Department Carnegie Mellon University Pittsburgh, PA 15213. This research is sponsored by the Hewlett-Packard Corporation, the Siemens Corporate Research, the National Science Foundation, the Army Research Office under Grant No. 4

[81] J.R. Saeta and J. Hernando, "On the Use of Score Pruning in Speaker Verification for Speaker Dependent Threshold Estimation", In The Speaker and Language Recognition Workshop (Odyssey), pages 215{218, Toledo, 2004.

[82] Garcia-Salicetti, S., Beumier, C., Chollet, G., Dorizzi, B., Leroux-Les Jardins, J., Lunter, J., Ni, Y. & Petrovska-Delacretaz, D., "BIOMET: a Multimodal Person Authentication Database Including Face, Voice, Fingerprint, Hand and Signature Modalities", Proc. 4th Conf. on AVBPA, pp. 845-853, Guildford, UK, July 2003.

[83] R. Sanchez-Reillo, C. Sanchez-Avilla, and A. Gonzalez-Marcos, "Biometric Identification through Hand Geometry Measurements," IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 22, no. 10, pp. 1168-1171, 2000.

[84] [C. Sanderson and K.K. Paliwal. "Fast Features for Face Authentication Under Illumination Direction Changes", Pattern Recognition Letters, 24(14):2409{2419, 2003.

[85] R. Sanchez-Reillo et C. Sanchez-Avila, "Two different approaches for iris recognition using Gabor filters and multiscale zero-crossing representation," Pattern Recognition Letters, vol. 3, pp. 231-241, 2005

[86] R .S. Smith, J. Kittler, M. Hamouz, and J. Illingworth, "Face Recognition Using Angular LDA and SVM Ensembles," in Proc. 18th Int'l Conf. on Pattern Recognition, 2006, pp. 1008–1012.

[87] K.-A. Toh, W.-Y. Yau, E. Lim, L. Chen, and C.-H. Ng., "Fusion of Auxiliary Information for Multimodal Biometric Authentication," in LNCS 3072, Int'l Conf. on Biometric Authentication (ICBA), pp. 678–685, (Hong Kong), 2004.

[88] U. Uludag, S. Pankanti, S. Prabhakar, and A. Jain. "Biometric cryptosystems : Issues and challenges", 2004.

[89] Saeed Usman, Jean-Luc Dugelay, "Facial video based response registration system", Eusipco 2008, 16th European Signal Processing Conference, August 25-29, 2008, Lausanne, Switzerland.

[90] A. Varga and H. Steeneken, "Assessment for Automatic Speech Recognition: NOISEX-92: A Database and an Experiment to Study the Effect of Additive Noise on Speech Recognition Systems", Speech Communication, 12(3):247{251, 1993.

[91] V. Viet Triem Tong, H. Sibert, J. Lecoeur et M. Girault. FingerKey, « un cryptosystème biométrique pour l'authentification ». Conférence sur la Sécurité et Architectures Réseaux, annecy : France. hal-00156447, version 1 - 28 Sep 2007

[92] Viola, P., Jones, M., " Robust real-time face detection". Internat. J. Comput. Vision 57 (2), 137–154, 2004.

[93] C. Vielhauer, R. Steinmetz, A. Mayerhöfer, "Biometric Hash based on Statistical Features of Online Signature", Proceedings Conference on Pattern Recognition (ICPR), August, Quebec City, Canada, ISBN 0-7695-1696-3, 2002.

[94] J. Wang, Y. Shang, G. Su, and X. Lin. "Age simulation for face recognition", In ICPR '06: Proc. 18th International Conference on Pattern Recognition, pages 913–916, 2006.

[95]] T. Wark, S. Sridharan, and V. Chandran. "Robust Speaker Verification via Asynchronous Fusion of Speech and Lip Information", In 2nd Int'l

Conf. Audio- and Video-Based Biometric Person Authentication (AVBPA'99), pages 37{42, Washington, D.C., 1999.

[96] J.L. Wayman, "Multi-Finger Penetration Rate and ROC Variability for Automatic Fingerprint Identification Systems", in N. Ratha and R. Bolle (eds.), Automatic Fingerprint Recognition Systems, Springer-Verlag, 2003

[97] J. Wayman, A. Jain, D. Maltoni, and D. Maio, "Biometric Systems: Technology, Design and Performance Evaluation", Springer, 2005.

[98] C. Wilson, A. R. Hicklin, M. Bone, H. Korves, P. Grother, B. Ulery, R. Micheals, M. Zoepfl, S. Otto, and C. Watson, "Fingerprint Vendor Technology Evaluation 2003: Summary of Results and Analysis Report," NIST, Technical Report NISTIR 7123, June 2004.

[99] Xiaolong Teng, Bian Wu, Weiwei Yu, Chongqing Liu, "A hand gesture recognition system based on local linear embedding", Journal of Visual Languages and Computing 16 (2005) 442–454

[100] Xiaoguang Lu and Anil. K. Jain, "Deformation modeling for robust 3d face matching," in Proc. IEEE Computer Society Conference on Computer Vision and Pattern Recognition, New York, NY, 2006, pp. 1377–1383.

[101] YingLiang, Ma., Pollick, F., & Hewitt, W.T., (2004), "Using B-spline curves for hand recognition", ICPR 2004. In Proceeding of the 17th international conference on 23–26 August 2004, (Vol. 3, pp. 274–277).

[102] J. You, W. Li, and D. Zhang, "Hierarchical Palmprint Identification via Multiple Feature Extraction," Pattern Recognition, vol. 35, no. 4, pp. 847-859, 2002

[103] D. Zhang, W.-K. Kong, J. You, and M. Wong. "Online Palmprint Identificaiton », IEEE. Trans. Pattern Analysis and Machine Intelligence, 25(9):1041{1050, 2003.

[104] D. Zhang and W. Shu, "Two Novel Characteristics in Palmprint Verification: Datum Point Invariance and Line Feature Matching," Pattern Recognition, vol. 32, no. 4, pp. 691-702, 1999.

[105] F. Zöbisch, C. Vielhauer, "A Test Tool to support Brut-Force Online and Offline Signature Forgery Tests on Mobile Devices", Proceedings of the International Conference on Multimedia and Expo 2003 (ICME), 6 - 9 Juli, Baltimore, MD, USA, ISBN 0-7695-1062-0, 2003, S. 60–64.

[106] R. L. Zunkel, Jain, R. Bolle, and S. Pankanti, "Hand geometry based verification," in Biometrics, A. Eds. Norwell, MA: Kluwer, 1999, pp. 87–101.

Score-Level Fusion for Efficient Multimodal Person Identification using Face and Speech

Hanaa S. Ali
Faculty of Engineering
Zagazig University
Zagazig, Egypt
hanahshaker@yahoo.com

Mahmoud I. Abdalla
Faculty of Engineering
Zagazig University
Zagazig, Egypt
mabdalla2010@gmail.com

***Abstract*—In this paper, a score fusion personal identification method using both face and speech is introduced to improve the rate of single biometric identification. For speaker recognition, the input speech signal is decomposed into various frequency channels using the multi-resolution property of wavelet transform. For capturing the characteristics of the signal, the Mel frequency cepstral coefficients (MFCCs) of the wavelet channels are calculated. For the recognition stage, hidden Markov models (HMMs) are used. Comparison of the proposed approach with the MFCCs conventional method shows that the proposed method not only effectively reduces the influence of noise but also improves recognition. For face recognition, the wavelet-only scheme is used in the feature extraction stage of face and nearest neighbour classifier is used in the recognition stage. The proposed method relies on fusion of approximations and horizontal details subbands normalized with z-score at the score level. After each subsystem computes its own matching score, the individual scores are finally combined into a total score using sum rule, which is passed to the decision module. Although fusion of horizontal details with approximations gives small improvement in face recognition using ORL database, their fused scores prove to improve recognition accuracy when combining face score with voice score in a multimodal identification system. The recognition rate obtained with speech in noisy environment is 97.08% and the rate obtained from ORL face database is 97.92%. The overall recognition rate using the proposed method is 99.6%.**

I. INTRODUCTION

A biometric is a biological measurement of any human physiological or behavior characteristics that can be used to identify an individual. One of the applications which most people associate with biometrics is security. However, biometrics identification has a much broader relevance as computer interface becomes more natural. Biometric technologies are becoming the foundation of an extensive array of highly secure identification and personal verification solutions. A biometric-based authentication system operates in two modes: enrollment and authentication. In the enrollment mode, a user's biometric data is acquired and stored in a database. The stored template is labelled with a user identity to facilitate authentication. In the authentication mode, the biometric data of a user is once again acquired and the system uses this to either identify or verify the claimed identity of the user. While verification involves comparing the acquired biometric information with only those templates corresponding to the claimed identity, identification involves comparing the acquired biometric information against templates corresponding to all users in the database [1]. In recent years, biometrics authentication has seen considerable improvements in reliability and accuracy. A brief comparison of major biometric techniques that are widely used or under investigation can be found in [2]. However, each biometric technology has its strengths and limitations, and no single biometric is expected to effectively satisfy the requirements of all verification or identification applications. Biometric systems based on one biometric are often not able to meet the desired performance requirements and have to be contend with a variety of problems such as insufficient accuracy caused by noisy data acquisition, interclass variations and spoof attacks [3]. For biometric applications that demand robustness and higher accuracy than that provided by a single biometric trait, multimodal biometric approaches often provide promising results. Multimodal biometric authentication is the approach of using multiple biometric traits from a single user in an effort to improve the results of the identification process and to reduce error rates. Another advantage of the multimodal approach is that it is harder to circumvent or forge [4]. Some of the more well-known multimodal biometric systems proposed thus far are outlined below.

In [5], a comparison of decision level fusion of face and voice modalities using various classifiers is described. The authors evaluate the use of sum, majority vote, three different order statistical operators, Behavior Knowledge Space and weighted averaging of classifier output as potential fusion techniques. In [6], the approach of applying multiple algorithms to single sample is introduced. In this work, a decision level fusion is performed based on sum, Support Vector Machine and Dempster-Shafer theory on multiple fingerprint matching algorithms submitted to FVC 2004 competition with a view to evaluate which technique to use for fusion. In [7], multiple samples of face from same and different sources are used to create a multimodal modal system using 2D and 3D face images. The approach uses 4 different 2D images and a single 3D image from each user for verification and

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

fusion takes place in parallel at matching score level using sum, product or the minimum value rule. Middendorff, Bowyer and Yan in [8] detail different approaches used in combining ear and face for identification. In [9], an overview of the development of the SecurePhone mobile communication system is presented. In this system, a multimodal biometric authentication gives access to the system's built-in e-signing facilities, enabling users to deal m-contracts using a mobile call in an easy yet secure and dependable way. In their work, signature data is combined with the video data of unrelated subjects into virtual subjects. This is possible because signatures can be assumed statistically independent of face and voice data. In his PhD thesis, Karthik [10] proposes a fusion strategy based likelihood ratio used in the Neyman-Pearson theorem for combination of match score. He shows that this approach achieves high recognition rates over multiple databases without any parameter tuning.

In this paper, we introduce a multimodal biometric system which integrates face and voice to make a personal identification. Most of the successful commercial biometric systems currently rely on fingerprint, face or voice. Face and speech are routinely used by all of us in our daily recognition tasks [11]. Despite the fact that there are more reliable biometric recognition techniques such as fingerprint and iris recognition, the success of these techniques depends highly on user cooperation, since the user must position his eye in front of the iris scanner or put his finger in the fingerprint device. On the other hand, face recognition has the benefit of being a passive, non intrusive system to verify personal identity in a natural and friendly way since it is based on images recorded by a distance camera, and can be effective even if the user is not aware of the existence of the face recognition system. The human face is the most common characteristics used by humans to recognize other people and this is why personal identification based on facial images is considered the friendliest among all biometrics [12]. Speech is one of the basic communications, which is better than other methods in the sense of efficiency and convenience [13]. For these reasons, face and voice are chosen in our work to build individual face recognition and speaker identification modules. These modules are then combined to achieve a highly effective person identification system.

II. FUSION IN BIOMETRICS

Ross and Jain [3] have presented an overview of multimodal biometrics and have proposed various levels of fusion, various possible scenarios, the different modes of operation, integration strategies and design issues. The fusion levels proposed for multimodal systems are shown in Fig. 1 and described below.

A. Fusion at the Feature Extraction Level

The data obtained from each sensor is used to compute a feature vector. As the features extracted from one biometric trait are independent of those extracted from the other, it is reasonable to concatenate the two vectors into a single new vector. The primary benefit of feature level fusion is the detection of correlated feature values generated by different feature extraction algorithms and, in the process, identifying a salient set of features that can improve recognition accuracy [14]. The new vector has a higher dimension and represents the identity of the person in a different hyperspace. Eliciting this feature set typically requires the use of dimensionality reduction/selection methods and, therefore, feature level fusion assumes the availability of a large number of training data.

B. Fusion at the Matching Score Level

Feature vectors are created independently for each sensor and are then compared to the enrollment templates which are stored separately for each biometric trait. Each system provides a matching sore indicating the proximity of the feature vector with the template vector. These individual scores are finally combined into a total score (using maximum rule, minimum rule, sum rule, etc.) which is passed to the decision module to assert the veracity of the claimed identity. Score level fusion is often used because matcher scores are frequently available from each vendor matcher system and, when multiple scores are fused, the resulting performance may be evaluated in the same manner as a single biometric system. The matching scores of the individual matchers may not be homogeneous. For example, one matcher may output a similarity measure while another may output a dissimilarity measure. Further, the scores of individual matchers need not be on the numerical scale. For these reasons, score normalization is essential to transform the scores of the individual matchers into a common domain before combining them [1]. Common theoretical framework [15] for combining classifiers using sum rule, maximum and minimum rules are analyzed, and have observed that sum rule outperforms other classifiers combination schemes.

C. Fusion at the Decision Level

A separate identification decision is made for each biometric trait. These decisions are then combined into a final vote. The fusion process is performed by a combination algorithm such as AND, OR, etc. Also a majority voting scheme can be used to make the final decision.

III. SPEAKER IDENTIFICATION EXPERIMENT

A. Feature Extraction Technique

Speech signals contain two types of information; time and frequency. The most meaningful features in time space are generally the sharp variations in signal amplitude. In the frequency domain, although the dominant frequency channels of speech signals are located in the middle frequency region, different speakers may have different responses in all frequency regions [16]. Thus, some useful information may be lost using the traditional methods which just consider fixed frequency channels.

In this paper, the multi-resolution decomposing technique using wavelet transform is used. Wavelets have the ability to analyze different parts of a signal at different scales. Based on this technique, one can decompose the input speech signal into different resolution levels. The characteristics of multiple frequency channels and any change in the smoothness of the signal can be detected. Then, the Mel-frequency cepstral

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

coefficients (MFCCs) are extracted from the wavelet channels to represent features characteristics.

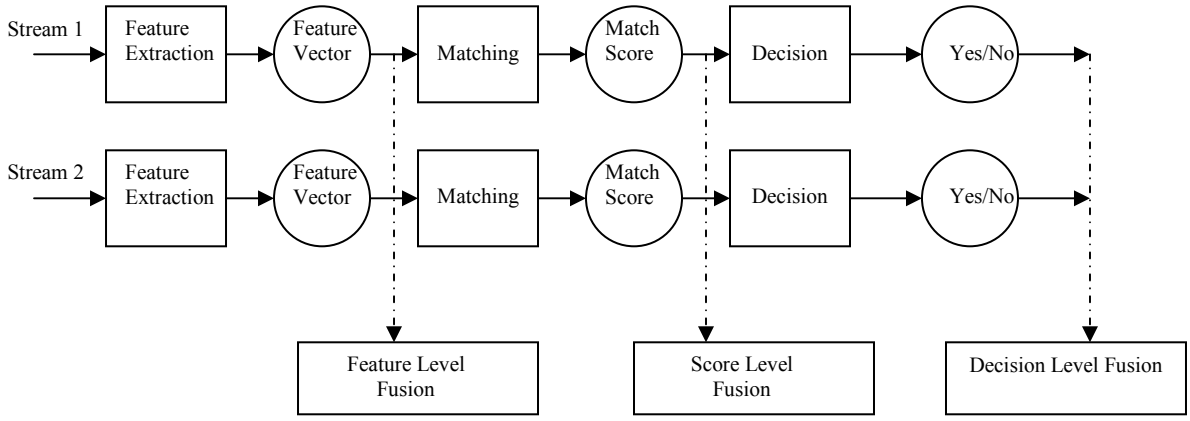


Figure 1. Fusion levels in multimodal biometric fusion.

The Mel-frequency cepstral (MFC) is a representation of the short-term power spectrum of a sound based on a linear cosine transform of a log power spectrum on a nonlinear Mel scale of frequency. In the MFC, the frequency bands are equally spaced on the Mel scale, which approximates the human auditory system's response more closely than the linearly-spaced frequency bands used in the normal cepstral. This frequency warping property can allow for better representation of sound [17]. In this way, the proposed wavelet-based MFCCs feature extraction technique combines the advantages of both wavelets and MFCCs.

B. Recognition Technique

In speaker identification, the objective is to discriminate between the given speaker and all other speakers. The goal is to design a system that minimizes the probability of identification errors. This is done by computing a match score. This score is a measure of similarity between the input feature vectors and some model. In this work, hidden Markov models (HMMs) are used in the recognition stage. HMMs are stochastic models in which the pattern matching is probabilistic. The result is a measure of likelihood, or conditional probability of the observation given the model. HMMs are used to model a stochastic process defined by a set of states and transition probabilities between those states. Each state of the HMM will model a certain segment of the vector sequence of the utterance, while the dynamic changes of the vector sequence will be modelled by transition between the states. In the states of the HMM, stationary emission processes are modelled, which are assumed to correspond with stationary segments of speech. Within those segments, the wide variability of the emitted vectors should be allowed [18].

C. Experiments, Results and Discussions

The database contains the speech data files of 40 speakers. These speech files consist of isolated Arabic words. Each speaker repeats each word 16 times, 10 of the utterances are for training and 6 for testing. The data were recorded using a microphone, and all samples are stored in Microsoft wave format files with 8000 Hz sampling rate, 16 bit PCM and mono channels.

The signals are decomposed at level 3 using db8 wavelet. For the MFCCs, the Mel filter bank is designed with 20 frequency bands. In the calculation of all the features, the speech signal is partitioned into frames; the frame size of the analysis is 256 samples with 100 samples overlapping.

A recognition system was developed using the Hidden Markov toolbox for use with Matlab, implementing a 4 states left-to-right transition model for each speaker, the probability distribution on each state was modelled as a 8 mixtures Gaussian with diagonal covariance matrix. It is often assumed that the individual features of the feature vector are not correlated, then diagonal covariance matrices can be used instead of full covariance matrices. This reduces the number of parameters and computational efforts.

HMMs are used with the proposed feature extraction technique, and the results are compared to HMMs used for recognition with the MFCCs alone. Also, in order to evaluate the performance of the proposed method in a noisy environment, the test patterns of 6 utterances are corrupted by additive white Gaussian noise so that the signal to noise ratio (SNR) is 20 dB. The results are summarized in Table I.

It is noted that the wavelet-based MFCCs give better results than MFCCs alone. Also, the performance of the system using MFCCs alone is affected significantly by the added noise, while the proposed technique demonstrate much better noise robustness with a satisfactory identification rate.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

TABLE I. RECOGNITION RATES PERCENTAGES USING THE PROPOSED AND THE MFCCS TECHNIQUES IN BOTH CLEAN AND NOISY ENVIRONMENT

Speech Signal	Feature Extraction Technique	Recognition Rate
Original clean signal	***Wavelet-based MFCCs***	99.17
	MFCCs	98.33
Noisy signal with S/N=20dB	***Wavelet-based MFCCs***	97.08
	MFCCs	92.92

IV. FACE RECOGNITION EXPERIMENT

A. Feature Extraction and Recognition Techniques

In recent years, wavelet transforms have been successfully used in a variety of face recognition schemes [19], [20], [21], [22]. In most cases, the approximation components only are used to represent face images as they give the best overall recognition accuracy. In this work, we investigate the effect of detail components by using different fusion techniques. Sellahewa and Jassim [23] demonstrated that the wavelet only scheme using approximation subbands is robust against varying facial expressions. Since we are investigating the recognition accuracy of different wavelet subbands under varying conditions, our study is based on the wavelet-only feature representation.

Tow-dimensional wavelet transform is performed by consecutively applying one-dimensional wavelet transform to the rows and columns of the two dimensional data [24]. Fig. 2 shows the tree representation of one level, two-dimensional wavelet decomposition. In this figure, H denotes low-pass filtering and G denotes high pass filtering. The scaling component A1 contains global low-pass information, and the three wavelet components, H1, V1, and D1 correspond respectively to the horizontal, vertical and diagonal details. This decomposition can be iterated by pursuing the same pattern along the scaling component.

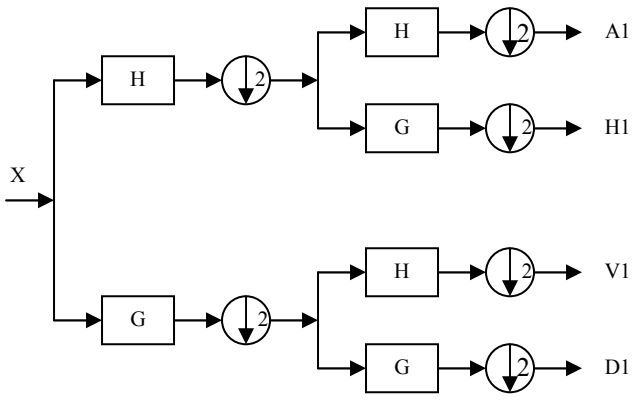


Figure 2. Tree representation of one-level 2D wavelet decomposition

The underlying idea in using multiresolution wavelet analysis is firstly to obtain multiple evidences from the same face, and search for those components that are less sensitive to different types of variations. Secondly, our approach follows the paradigm of fusion that uses multiple evidences from the face image. Although these evidences contain less information and appear somewhat redundant, the combination of their scores can prove often to be superior when combining face score with voice score in a multimodal identification system.

When a new face image is presented for identification, wavelet transform is applied on this image and the appropriate component is selected as the feature vector. A match score is then calculated between the test feature vector and the feature vectors of all the stored images using nearest-neighbour classifier (Euclidean distance).

B. Database

The performance of face recognition techniques is affected by variations in illumination, pose and facial expressions. Most existing techniques tend to deal with one of these problems by controlling the other conditions. Face recognition systems used in high secure areas in which only a limited number of persons are allowed can be based on face recognition systems. These systems are expected to be robust against all variations. In this work, the ORL database is used.

Figure. 3 Example images from ORL database

It consists of face images for 40 subjects, each with 10 facial images of 92*112 pixels. For most subjects, the images were shot at different times and different lighting conditions, but always against a dark background. The images incorporate moderate variations in expressions (open / closed eyes, smiling / not smiling), pose, orientation and facial details (glasses / no

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

glasses). Fig. 3 shows a sample of the database. The complete database is available to download at [25].

C. Experiments, Results and Discussions

The 10 facial images per subject are divided into 4 images for training and 6 for testing. To facilitate the wavelet decomposition down to level 3, the images are cropped to be of size 80*96. The Haar wavelet which is the simplest orthonormal wavelet with compact support is used in our experiments.

Table II shows the recognition rates from different subbands at different levels. It is noted that the highest recognition accuracy is obtained using approximations A3, followed by the horizontal details H3. The last four rows are reserved for the vertical and diagonal details on two successive levels, where one can observe the poor performance with these components.

Wavelet Subband	Recognition Rate
A3	96.67
H3	93.75
H2	86.6
H1	79.1
V3	84.5
V2	80.8
D3	79.5
D2	75

TABLE II. RECOGNITION RATES PERCENTAGES FROM DIFFERENT SUBBANDS AT DIFFERENT LEVEL

The second stage in our experiments was to study the effects of different normalization techniques on the most successful subbands. These techniques are histogram equalization (HE), and z-score normalization (ZN).

Z-score is performed on the selected wavelet subband coefficients by subtracting the mean and dividing by the standard deviation. Histogram Equalization is applied in the spatial domain. This process involves transforming the intensity values so that certain features are easier to see. It is an image enhancement technique that maps an image's intensity values to a new range. Table III shows the effect of applying HE and ZN as a pre-processing step. It is noted that ZN leads to an improvement in the recognition accuracy, while HE give no improvement and may lead to a decrease in the recognition accuracy using ORL database.

The third stage in the face recognition experiment is the fusion stage, with fusions realized at the feature level and also at the score level using sum rule. The subbands involved in the fusion are A3 and H3 with ZN applied as a pre-processing stage. These subbands were selected on the basis of their performances in single band experiments. The results are given in Table IV. It is noted that fusion at the feature level may lead to a decrease in the recognition accuracy, while fusion at the score level gives small improvement compared to using A3 single stream only. This led us to the final stage of our work, which is to add the face score with voice score in a multimodal biometric system. The face score can be taken as the score of A3 only, or the score of A3 when fused with H3. It is required to add the face score in both cases with voice score and compare the results.

TABLE III. RECOGNITION RATES BASED ON DIFFERENT NORMALIZATION TECHNIQUES

Wavelet Subband	Normalization Technique	Recognition Rate
A3	***None***	96.67
	HE	96.25
	ZN	97.5
	HE,ZN	95.42
H3	***None***	93.75
	HE	93.33
	ZN	94.17
	HE,ZN	93.33

TABLE IV. EFFECT OF FUSION OF WAVELET SUBBANDS ON RECOGNITION RATE

Feature	Recognition Rate
A3 with ZN	97.5
H3 with ZN	94.17
Fusion of A3 and H3 at the score level	97.92
Fusion of A3 and H3 at the feature level	97

V. MULTIMODAL SCORE FUSION

To improve the rate of single biometric identification, face and speech modalities are combined in a multimodal personal identification system. The scores of both modalities are combined using different fusion techniques. It is noted from previous experiment that, fusion of horizontal details with approximations gives small improvement compared to using approximations only, but of course the scores obtained in these two cases are different. It is noted that the scales of the distances produced by approximation bands and the detail bands are different. It is noted also that in case of errors in identification, the difference between distance scores is small using approximations only. Fusion of horizontal details and approximations at the score level reflects a bigger difference between distance scores. Table V gives the recognition rate of each single modality and the recognition rate after the score level fusion of both modalities using sum rule. First, the face score is taken as the score obtained from A3 only and fused with the voice score. Second, the face score is taken as the score obtained from A3 and H3, and then fused with the voice score. In the latter case, the overall recognition accuracy obtained is 99.6%, compared to 98.33% when using the score of A3 as the face score. In both cases the recognition rate of the

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

multimodal system is higher than the rate of single biometric. It is clear that the bigger difference between distance scores obtained when H3 is fused with A3 reflects in higher recognition rate when the face and voice scores are fused using sum rule.

TABLE V. RECOGNITION RATES OF UNIMODAL AND AMULTIMODAL BIOMETRIC SYSTEM USING DIFFERENT FUSION TECHNIQUES

Biometric	Recognition Rate
Voice	97.08
Face (A3 only)	97.5
Face(Fusion of A3,H3 at the score level)	97.92
Face and voice (score of face is the score of A3 only)	98.33
Face and voice (score of face is the fused score of A3 and H3)	99.6

VI. CONCLUSION

In this paper, we propose a personal identification method using combined face and speech information in order to improve the rate of single biometric identifier. We use wavelet-based MFCCs for speech feature extraction and HMMs for recognition. Wavelet multi-resolution analysis is used for face feature extraction and nearest neighbour classifier is used for recognition. Based on the experimental results, we show that fusion of horizontal details and approximations at the score level gives a big difference between distance scores. This reflects improvement in the overall recognition rate when the face score is fused with the voice score using sum rule. The results show that multimodal system performs better as compared to unimodal biometrics with a recognition rate of 99.6% compared to 97.92% using face only and 97.08% using speech only.

ACKNOWLEDGMENT

The authors would like to thank Professors Andrew Morris (Research Associate, Dept. of Phonetics, Saarbrücken University, Germany) and Harin Sellahewa (Research Lecturer, Buckingham University) for helpful discussion through emails.

REFERENCES

[1] T. Ko, "Multimodal Biometric Identification for Large User Population Using Fingerprint, Face and Iris Recognition", in *Proc. AIPR'05, 2005,* p. 218 - 223.

[2] A. Jain, R. Bolle, and S. Pankanti, *Biometrics Personal Identification in Networked Society,* USA: Kluwer Academic Publishers, 1999.

[3] A. Ross and A. Jain, "Information Fusion in Biometrics", *Pattern Recognition Letters,* vol. 24, pp. 2115–2125, Sep. 2003.

[4] A. Baig, A. Bouridane, F. Kurugollu, and G. Qu, "Fingerprint – Iris Fusion based Identification System using a Single Hamming Distance Matcher", *International Journal of Bio-Science and Bio-Technology,* vol. 1, pp. 47-58, Dec. 2009.

[5] F. Roli and J. Kittler, *Multiple Classifier Systems,* ser. Lecture Notes in Computer Science. Berlin, Germany: Springer, 2002, vol. 2364.

[6] J. Fierrez-Aguilar, L. Nanni, J. Ortega-Garcia, R. Cappelli, and Davide Maltoni, "Combining Multiple Matchers for Fingerprint Verification: A Case Study in FVC2004", 2004.

[7] K.I. Chang, K.W. Bowyer, and P.J. Flynn, "An Evaluation of Multimodal 2D+3D Face Biometrics", *IEEE Transactions on Pattern Analysis and Machine Intelligence* ,vol. 27, pp. 619-624, April 2005.

[8] C. Middendorff, K.W. Bowyer, and P. Yan, "Multi-Modal Biometrics Involving the Human Ear", in *Proc.IEEE CVPR'07, 2007,* p. 1-2.

[9] J. Koreman, S. Jassim, et al, "Multi-Modal Biometric Authentication on the SecurePhone PDA", Cite SeerX [Online]. Available: http://mmua.cs.ucsb.edu/MMUA2006/Papers/132.pdf

[10] K. Nandakumar, "Multibiometric Systems: Fusion Strategies and Template Security", PhD thesis, Michigan State University, 2008.

[11] A. Jain, L. Hong, and Y. Kulkarni, "A multimodal Biometric System Using Fingerprint, Face, and Speech", Available Online: www.cse.msu.edu/biometrics/Publications/Fingerprint/MSU-CPS-98-32.pdf.

[12] A. S. Tolba, A.H. El-Baz, and A.A. El-Harby, "Face Recognition: A Literature Review", *International Journal of Signal Processing*, vol. 2, pp. 88-103, 2006.

[13] C. Park, T. Choi, et al, "Multi-Modal Human Verification Using Face and Speech"", in *Proc. ICVS'06, 2006,* p. 54.

[14] J. Thiran, F. Marques, and H. Bourlard, *Multimodal Signal Processing,* Elsevier Ltd, 2010.

[15] J. Kittler, M. Hatef, R. P. W. Duin, and J. Mates, "On Combining Classifiers", *IEEE Transactions on Pattern Analysis and Machine Intelligence,* vol. 20, pp. 226-239,1998.

[16] C. Hsieh, E. Lai, and Y. Wang, "Robust Speaker Identification System based on Wavelet Transform and Gaussian Mixture Model", *Journal of Information Science and Engineering*, vol. 19, pp. 267-282, 2003.

[17] Wikipedia website. [Online]. Available: http://en.wikipedia.org.

[18] L.R. Rabiner, "A Tutorial on Hidden Markov Models and Selected Applications in Speech Recognition", *Proceedings of the IEEE*, vol.77, 1989.

[19] J. H. Lai, P.C. Yuen, and G. C. Feng, "Face Recognition using Holistic Fourier Invariant Features", *Pattern Recognition,* vol. 34, pp. 95_109, 2001.

[20] J. T. Chien and C. C. Wu, "Discriminant Wavelets and Nearest Feature Classifiers for Face Recognition", *IEEE Transactions on Pattern Analysis and Machine Intelligence,* vol. 24, pp.1644-1649, Dec. 2002.

[21] H. K. Elkenel and B. Sankur, "Multiresolution Face Recognition", *Image and Vision Computing,* vol. 23, pp. 173-183, March 2005.

[22] H. Sellahewa and S. Jassim, "Wavelet-Based Face Verification for Constrained platforms", in *Proc. SPIE Biometric Technology for Human Identification,* vol. 5779, pp. 173-183, March 2005.

[23] H. Sellahewa and S. Jassim, "Face Recognition in the Presence of Expression and/or Illumination Variation", *in Proc. The 4th IEEE Workshop Automatic Identification Advanced Technologies,* pp. 144-148, Oct. 2005.

[24] R. C. Gonzalez, and R. E. Woods, *Digital Image Processing,* Pearson Education, Inc., New Jersey, 2008.

[25] AT&T Laboratories, Cambridge University Computer Laboratory, [Online].Available: http://www.uk.research.att.com/facedatabase.html.

Access Control Via Biometric Authentication System

Okumbor Anthony N.[1]
Computer Centre, Delta State Polytechnic,
Otefe-Oghara, Nigeria
tonyokumbor@yahoo.com

S. C. Chiemeke (Ph.D)[2]
Associate Professor
Computer Science, University of Benin
Benin City, Nigeria

***Abstract*— Presently, the conventional systems such as possession of an object like a key or identity card, or the knowledge of a password or login used by the Delta State government of Nigeria to verify her personnel for access to the state scholarship scheme are prone to a lot of inadequacies, such as fraud and identity theft. In other to overcome this problem, this research proposes an alternative solution in the area of Biometrics technology using advanced computer techniques as a widely adopted front-line security. In this research, the concept and related literatures is reviewed. The method adopted in carrying out the research, is study of the existing system and evolutionary prototyping of the new system. The developed solution is essentially a pattern recognition system that captures an individual data and fingerprint and uses the minutiae algorithm as a determinant for authentication. The application is developed using the Visual Basic.Net framework for the front-end, fingerprint SDK as a component and MS SQL Server for the backend. 'BioPersonnel Authenticator' provides positive identification; it is user friendly, flexible and supports various device. On deployment of the application it serves as a data repository for the state and it is recommended for adoption by other organs of government.**

Keywords- Authentication, Biometrics, Template and Reference

I. INTRODUCTION

Background Information

The emerging trend in organizations is the security of physical, financial, and information assets. Lapses in security such as unauthorized personnel gaining access to government facilities and schemes can have serious consequences that extend beyond the organization. Organizations need to have an absolute trust in the identity of their employees, customers, contractors, and partners; that they are who they claim to be.

Personal identity refers to a set of attributes for example name, employee number, etc. that are associated with a person. In the modern day society, there is an ever-growing need to determine or verify the identity of a person. Identity management can be said to be a process of creating /linking the attributes to a physical person. One of the critical tasks in identity management is person authentication, where the goal is to either determine the previously established identity of an individual or verify an individual's identity claim. This can be accomplished by three methods [4]. The two conventional methods of authentication are based on a person's exclusive possession of a token (e.g., ID card or key) or knowledge of a secret (e.g., password). The third method, called biometric recognition, authenticates a person based on his biological and behavioral (biometric) traits. In other words, biometrics refers to the automated recognition of individuals based on their biological and behavioral traits. Examples of biometric traits include fingerprint, face, iris, palmprint, retina, hand geometry, voice, signature and gait.

Biometric Systems

A biometric system is essentially a pattern recognition system that recognizes a person by determining the authenticity of a specific physiological and/or behavioral characteristic possessed by that person. An important issue in designing a practical biometric system is to determine how an individual is recognized. Depending on the application context, a biometric system may be called either a verification system or an identification system:

a verification system authenticates a person's identity by comparing the captured biometric characteristic with her own biometric template(s) pre-stored in the system. It conducts one-to-one comparison to determine whether the identity claimed by the individual is true. A verification system either rejects or accepts the submitted claim of identity (Am I whom I claim I am?);

an identification system recognizes an individual by searching the entire template database for a match. It conducts one-to-many comparisons to establish the identity of the individual. In an identification system, the system establishes a subject's identity (or fails if the subject is not enrolled in the system database) without the subject having to claim an identity (Who am I?).

The term authentication is also frequently used in the biometric field, sometimes as a synonym for verification; actually, in the information technology language, authenticating a user means to let the system know the user identity regardless of the mode (verification or identification) [7].

However, identification of a person can be based on any of these physiological or behavioral characteristics. Today there are many biometric devices based on characteristics that are unique for everyone. Some of these characteristics include, but are not limited to, fingerprints, hand geometry, and voice. These characteristics can be used to positively identify someone. Many biometric devices are based on the capture and matching of biometric characteristics in order to produce a positive identification. By employing a biometric device or system of devices inside the government system, it will enable organizations to tell exactly who is an employee of the state.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Every biometric device or system of devices includes the following three processes: enrollment, live presentation, and matching. The time of enrollment is when the user introduces his or her biometric information to the biometric device for the first time. The enrollment data is processed to form the stored biometric template. Later, during the live presentation the user's biometric information is extracted by the biometric device and processed to form the live biometric template. Lastly, the stored biometric template and the live biometric template are compared to each other at the time of matching to provide the biometric score or result [3].

Problem Statement

The question that is increasingly being asked of individuals by government organizations in their bid to fight fraud, organized crime and the menace of identity theft as well as to combat corruption is "Are you the personnel who you claim to be".

Currently, personnel identification for the access to state scholarship and control system rely on the use of PIN, Identity cards and token. These besides being inconvenient and vulnerable to manipulations and fraud, does not identify the person but simply identify the information that is provided by that person.

To achieve a more reliable verification or identification process, this research seeks to use a trait that really characterizes the given person. Biometrics offer automated method of identity verification on the principle of measurable physiological or behavioural characteristics such as the use of Fingerprint sample. The fingerprint is the most widely used biometric trait and it is believed to be unique to every individual.

This type of identification would be more reliable when compared with traditional verification methods such as possession of an object like a key or swipe card, or the knowledge of a password or login to access a scheme, because the person has to be physically present at the time of identification. Reliable personal identification is important in everyday transactions, biometric identification could decrease millions of naira lost every year to fraud, by providing near irrefutable proof of identification.

Research Objectives

The goal of this study include to:

- Develop a biometric system for capturing data of employees that would ensure only legitimate personnel of the Delta state extraction have access to the scholarship scheme.
- Develop a system that ensures identity verification and control access to the scholarship scheme.
- Ensure the State takes full advantage of the emerging trend in Information Technology.

Significance and Scope

Against the backdrop of the mediocrity observed in the public sector performance since 1990, where paper-based personnel records are one of the significant and space-consuming categories of records found in the public sector. The major significance of this work lies in the necessity to articulate a new agenda for employees' identity in the public sector. It is expected that this study will serve as literature review to other students and most importantly, it is envisaged that it should be useful to public policy analyst, policy makers and scholars. Its major focus is designing a fingerprint recognition system using Delta State Scholarship Board as a test case.

II. REVIEW OF LITERATURE

All fingerprints are believed to be unique to each person and finger; even twins do not have the same fingerprints [4]. Fingerprint technology is the most developed technology in biometric recognition [2] and is legitimate proof of evidence in courts of law all over the world [5]. Fingerprint recognition has been used for a significant amount of time. The "Henry system" was developed in the early 1800's by Edward Henry to classify and identify fingerprints based on the ridge configurations and was revamped by the FBI in the early 1900's [2]. The categories are based on the global patterns of the ridges and valleys, the human fingerprint can have many different ridge patterns.

"Reference [1] noted that, Biometrics such as fingerprints and handprints have been in use since ancient times". The first modern systematic use of fingerprint verification appears to have been used in India during the mid-19th century. Azizul Haque developed indexing fingerprints for Edward Henry, the inspector general of police in India. Colonial officials used this technique to stop impersonation of pensioners who had died and to prevent rich criminals from paying poor people to serve their jail sentences for them. Later in the 1900s, fingerprints passed into mainstream police use. In the 1970s, electronic readers were developed, which led to the emerging biometric technologies in use today.

FINGERPRINT RECOGNITION

Every person possesses unique fingerprints from any other individual. As with other biometric methods, fingerprint identification is based on two basic premises:

Invariance: The basic characteristics of the fingerprint do not change with time. However, there are instances where a fingerprint reader may not accept a legitimate user because of a cut on the finger or dry skin.

Singularity: The fingerprint is unique to each individual and no two people have the same pattern of fingerprints.

Fingerprint-based identification has been used for a long time and is routinely used in forensic laboratories and identification units all around the world. Fingerprint evidence has also been accepted in courts of law for nearly a century [6]. The population as a whole is familiar with fingerprint identification methods and this familiarity makes this technique have a high user acceptance rate.

Fingerprint patterns can be represented by a large number of features including the overall ridge flow pattern, ridge, frequency, location and position of singular points [12]. It

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

would probably be difficult to guess the digital representation of a fingerprint pattern without having the actual finger present.

A. How Fingerprint Recognition Works

A fingerprint-scanning device is pretty easy to use. The user must place his or her finger on the device and certain characteristics of the fingerprint image are extracted into templates known as minutiae. The characteristics of each finger are different from each other.

Recall that finger-scanning systems only store data about specific points of the fingerprint. The only way an impostor would be able to spoof a user to a finger scanning system is by having a legitimate user present his or her finger to the scanning device or to somehow obtain an image of a legitimate user's fingerprint. If a biometric authentication system includes fingerprint-scanning device, liveness testing must be employed. One way to employ liveness testing in fingerprint scanning is to have the device equipped with a "heartbeat checking" mechanism which would measure whether a heart beat or pulse is present while the user is touching the device. This would require the user to hold his or her finger on the scanning device a little bit longer than usual.

As with other biometric methods, general fingerprint matching process involves three phases:

- The acquisition phase or enrollment is where the fingerprint is scanned using a fingerprint sensor. Many sensors are available that capture a fingerprint based on the optical, capacitive, pressure, thermal, or ultrasound domain. The capturing of the image is made easier because the sensors only require a simple touch of a finger.
- The live presentation phase is when the user shows his/her biometric information to the biometric device.
- During the matching phase, the features of the scanned fingerprint (live template) are compared to the stored template in the database.

Since traditional methods of fingerprinting (i.e. fingerprint capturing using ink and paper) are not used than often in fingerprint recognition technology, we are able to capture more details of that fingerprint. In addition, the newer methods of fingerprint recognition are more hygienic and less intrusive. In order for the system to offer accurate results the user has to be willing to use it correctly and they have to be willing to fully understand how the system works. For example, the user will have to know how long they would have to press their finger on the reader in order to obtain accurate results.

B. User Influences on Fingerprint Recognition:

Fingerprint recognition methods contain influences that may affect the outcome of the authentication process of the device. Some influences are [10].

- Fingernail growth may have an effect on how firmly the user is able to place his/her finger on the scanning device. This may result in inaccurate results from the device or the user may be rejected altogether by the system. This influence also extends itself to the use of artificial nails that the user may apply to real fingernails.
- Fingerprint fineness may also have an effect on how the device is able to pick up details of the fingerprint. This depends on how well the depth and the spacing of ridges are on the users fingers. This influence is not controllable by the user so proper enrollment from the beginning needs to be done as well as proper placement of the finger on the scanning device at the time of authentication. There may be fingerprint-scanning devices that alleviate this influence by offering a sensitive "touching area" for the user.
- The condition of the fingerprint may have an effect on the outcome of the device because the user may have dry, cracked, or damp fingers. If the user has dry, cracked, or damp fingers at the time of enrollment or at the time of authentication the scanning device may not be sensitive enough to compensate for these characteristics. Another influence that falls into this category is scars and/or scratches on the fingertips of the user. Scars and scratches, depending on their location, may cover up some important characteristics of the fingerprint that the scanning device is looking for to extract. On the other hand, it may be possible for the scanning device to simply use the scar on the fingertip as a part of the characteristic extracted.
- Temperature of the user's finger or hand. The temperature of the user's finger may cause inaccurate results from scanning device.

C. Fingerprint Sensors

A fingerprint sensor is an electronic device used to capture a digital image of the fingerprint pattern. The captured image is called a live scan. This live scan is digitally processed to create a biometric template (a collection of extracted features) which is stored and used for the matching.

The methods used to gather fingerprint information has changed greatly over the years. Some sophisticated fingerprint scanning methods have emerged since the beginnings of this method of identification. Some sophisticated methods currently available are Optical sensors with CCD or CMOS cameras, Ultrasonic sensors, Electronic field sensors, capacitive sensors and Temperature sensors [11].

Although these techniques seem very advanced and accurate, it is still possible that a desperate impostor may attempt to spoof a legitimate user by creating fake fingers. Fake fingers can be made both by the cooperation of the legitimate user (i.e. for testing methods) or without the cooperation of the legitimate user by lifting a fingerprint off of a keyboard or coffee mug. Those traces of fingerprints are known as latent fingerprints. Tsutomu Matsumoto, a Japanese cryptographer, has discovered a means to fool many of the commercial fingerprint scanners available using common ingredients [8]. .

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

The success of a biometric device lies in the acceptance of that device by the users. If the device is easy to use and does not take too much user time, then most likely it will be accepted and used correctly. On the other hand, if it is difficult to use or takes too much time from the user, the success of the device will be greatly reduced.

D. Techniques of Fingerprint Recognition:

Several techniques have been developed in order to match fingerprints. A (three-class) categorization of fingerprint matching approaches is [7].

Correlation-based matching: two fingerprint images are superimposed and the correlation (at the intensity level) between corresponding pixels is computed for different alignments (e.g., various displacements and rotations);

Minutiae-base matching: minutiae are extracted from the two fingerprints and stored as sets of points in the two-dimensional plane. Minutiae matching essentially consist of finding the alignment between the template and the input minutiae set that results in the maximum number of minutiae pairings;

Ridge feature-based matching: minutiae extraction is difficult in very low-quality fingerprint images, whereas other features of the fingerprint ridge pattern (e.g., local orientation and frequency, ridge shape, texture information) may be extracted more reliably than minutiae, even though their distinctiveness is generally lower. The approaches belonging to this family compare fingerprints in term of features extracted from the ridge pattern.

Minutiae-Based Algorithms

In this technique, the user places a finger on the scanner; the image is then encrypted and sent to the host computer where the processing takes place. The image is formed of dark lines (ridges) and lighter lines (valleys).

The methodology that most matching algorithms are based on is minutiae matching. Minutiae are particular features of the lines on the fingerprint. The most commonly used ones are bifurcation, where the ridge forks to take two different paths and ridge endings, where the ridge begins or ends [9].

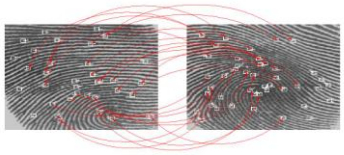


Figure 1: Minutia (*Image source* National Institute of Standards and Technology)

For the computer to be able to identify minutiae, the image must undergo some pre-processing first. Most images from a fingerprint scanner are in grey scale, this makes it difficult to distinguish between ridges and valleys. Therefore the image is converted in to a binary image. This is done by calculating the average pixel colour value over small areas of the image (typically an arc is 8x8 pixel), any pixel with a value higher than the average colour value is converted to black, anything below is converted to white.

Noise reduction then takes place to reduce interference. Finally the image is thinned so that the ridge lines are only one pixel thick. Thinning enables the computer to identify ridge ending and bifurcation by pixel transition counting. This method involves counting how many transitions from black to white are made when traversing round the surrounding pixels of the user minutia. If a user minutia is truly a ridge ending then there will only be one transition, if it is a bifurcation there will be three transitions.

Then the detected minutiae are stored on a template at their relative coordinates. The lines next to the minutiae represent the direction in which the line is traveling. This template is stored in a database if enrolling the user. If trying to authenticate the user, the template is then compared to templates already in the database. A predefined threshold is set; if the number of matching minutiae is greater than the threshold value it is deemed a match else a mismatch.

III. RESEARCH METHODS

The research method adopted is the Structural Systems Analysis and Design (SSADM), which is an accepted Software Engineering principle for designing software, is a systems approach to the analysis and design of information systems. The method involves the application of a sequence of analysis, documentation and design tasks concerned with for instance, analysis of the current system. One of the most important techniques, Data Flow Modeling was used to identify the major current system processes. Also adopted is the Evolutionary Prototyping methodology which is an approach to system development where an initial prototype is produced and refined through a number of stages to the final system. The objective of evolutionary prototyping is to deliver a working system to end-users. The development starts with those requirements which are best understood. The main goal when using evolutionary prototyping is to build a prototype in a structured manner and constantly refine it. The reason for this, is that the evolutionary prototype, when built forms the heart of the new system, and the improvement and further requirement will be built.

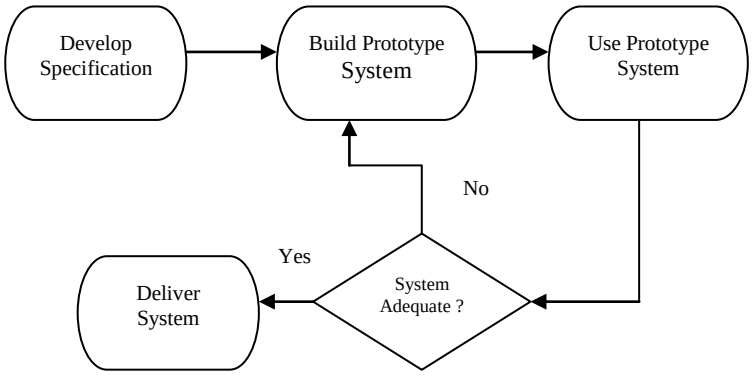


Figure 2, Evolutionary Prototyping

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Architectural Framework of the Systems

A. The Existing System

In studying the operations of the existing system, the research made use of interview, examination of records and observation of officers in the Delta State establishments and the State scholarship board. The interview method was conducted with the Head of Service, officers of Scholarship Board and other establishments to understand how the current system of personnel records operates and modalities for award of scholarship to the state employees. The examination of records was to access how old records are being stored, while observation method is to understand how personnel's who wish to further their education are been authenticated for scholarship award.

Scholarship has been awarded to deserving personnel of Delta State origin. To qualify for such awards the personnel has to prove her identification by way of identity cards, personnel PIN and records, evidence of admission and through manual recommendation from the Head of Service based on the available records.

The establishment essentially consists of activities taking place within the organization. As such it has the ability to identify major system processes as seen through the eyes of the people performing them. It is the people the researcher interviewed to get an understanding of a system under consideration. These processes as jotted down gives rise to the Data flow Diagram.

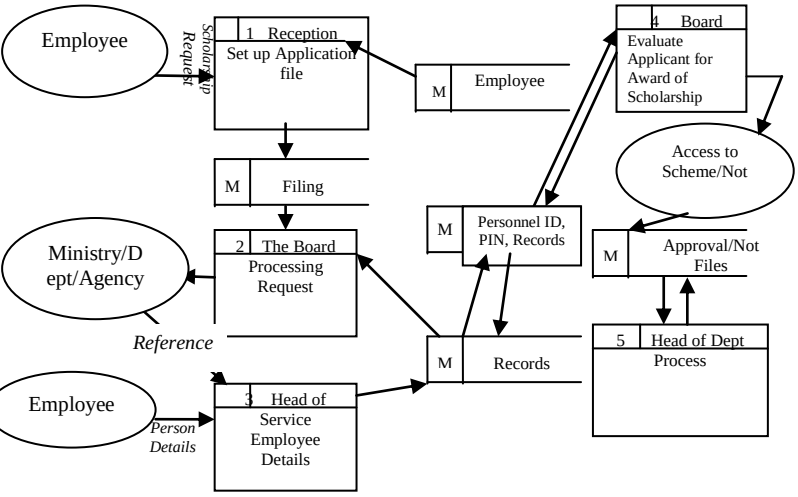


Figure 3, Data Flow Diagram of Existing System.

At the highest level DFD, one arrow may represent several data flows.

External sources or destinations of data, which may be people, programs, organizations or other entities which interact with the system but are outside its boundary are represented with the oval. Each external entity communicates in some way with the system, so there is always a flow of data shown between a process in the system and an external entity.

Data Store, here data are stored or referenced by a process in the system. The data store may represent computerized or non computerized devices. It may be a filing cabinet, an in-tray, a card index, a reference book or a computer file. Anywhere that data is stored and retrieved is a data-store. The notation is simple: a long, open-ended rectangle with a box at the left end. The box is labeled with an alpha pre-fix. The alpha is either D (for an automated data store) or M (for a manual/card data store). The rectangle is labeled with a description of the contents of the data store.

Process, a process is an activity that receives data and carries out some form of transformation or manipulation before outputting it again. It is depicted by a box divided into three parts: the upper left position is given a number. This has no significance other than as a reference number; it does not imply priority or sequence. The longer top rectangle beside it names the location where the processing takes place; the rest of the box describes what is happening in the process.

From the foregoing, it is obvious that the existing system process for scholarship award authentication is very cumbersome, time consuming and gives room for impersonation and fraud.

Merits and Demerits of Existing System

Merits:

The paper-based personnel records are one of the most significant and space consuming categories of records found in the public sector. It is argued that because personnel records needs to be retained over a long period, generally well beyond the time the staff reach retirement age that it gives room for proper identity verification.

Demerits:

- Unfortunately, there are no widely accepted conventions relating to the order in which personnel names are written or spelled. This causes filling, retrieval and identification problems.
- Despite the requirement for confidential and security, often records are inadequately protected.
- Even where personnel files are held centrally, such as in the office of the Head of Civil Service, it is normal for ministries and departments to create their own files. Without clear policies or procedures on the management of these files, it is not uncommon to find that as civil servants are transferred from one Ministry or department to another the files do not travel with them. This result in multiple files both open and closed on any personnel.
- The existence of multiple files relating to the same employee makes it difficult to determine which records should be kept or use to verify personnel for a scholarship scheme.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

B. The Proposed System

The proposed system links the person to his/her previously established identity through automated means. The merits are numerous:

- With Biometrics the speed and efficiency with which information can be supplied to authenticate users will be enhanced.
- It can detect irregularities, thus lessen opportunities for fraud.
- Since biometric recognition requires the personnel to be present at the time of authentication, it can deter users from making false repudiation claims.
- The technology offers a more secure automated method to authenticate identity, since one can't loose, forget or share their biometric information
- Moreover, only biometric can provide negative identification functionality where the goal is to establish whether a certain individual is enrolled in a system although the individual might deny it.

Due to these, biometric recognition has been widely hailed as a natural, reliable and irreplaceable component of any identity management system.

Demerits:

- Public acceptance and Privacy are the most issues with implementing this new system or method. If the public does not accept the notion of biometrics, it would be difficult to implement successfully because it would not be used and there is a long list of legal issues that biometrics imposes. For instance, public advocacy groups may claim that the retention of biometrics information is an invasion of civil rights.

C. Justification of the New System

The records based, ID's card and use of PIN are widely adopted as solution for identification of individuals for the award of scholarship, and these methods present a lot of short comings as explained above.

The ID's, PIN may be lost, forgotten, easily guessed, impersonation or even broken by fraudulent attacks and records falsified to enable embezzlement of funds. In addition, those methods are characterized by their non-repudiation, which means that it becomes impossible to know who the actual beneficiary is. Due to these facts, those system alone are not enough to guarantee reliable human identification.

In this sense, Biometric recognition forms a strong link between a personnel and his identity because biometric traits cannot easily be shared, lost or duplicated. Hence, biometric is intrinsically superior and more resistant to social engineering.

IV. THE SYSTEM DESIGN

The purpose of the system design is to document exactly how a system should work. In essence, preparing a detailed set of specifications to:

- Capture the data of state personnel and using the fingerprint recognition method for authentication for access to scholarship.
- Develop the overall system logic, in which the architecture will also address the interface between the software system, the component (GrFinger Sdk) and other software products.
- Integrate and query of the database.

A. Control Centre

The Control Centre structure follows as:

Main	The main window, has the bio-data, form, displays the fingerprint image, handles events, initializes and finalizes the sample
Util	Methods responsible for initializing and finalizing the fingerprint sdk, library, performing the basic biometric operation like identification, verification, fingerprint enrollment and also support routines, like adding messages to the log box or checking if a fingerprint template is valid.
Db	Methods responsible for adding and retrieving data from database.
Option	The options window.

B. Database Specification

The database management system used for this system is Microsoft SQL Server 2005. MS SQL Server was used to create database tables, queries etc. The database table was fully accessed using OLE DB (Object Linking Embedding Database) connection from the front end application programming interface (API). OLE DB provides an API for accessing database system programmatically or visually. It is a set of interface implemented using the component object model (COM). SQL statements were used to query the database table to retrieve, modify or delete records from the database table.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

C. Program Module Specification

The entire system was broken into subsystems. Each subsystem was designed to interoperate as a single module The application has four basic steps:

1. Initialing the fingerprint sdk (GrFinger) library.
2. Start capturing bio-data and image from a fingerprint reader (this application used Cross Match Reader) or loading from file.
3. Extracting a template for each image.
4. Choosing among enrolling a template or matching it against others on database

D. Input/Output Format for the Program

The input/output to the system is designed to be accepted from electronic keyboard, webcam/digital camera and fingerprint reader. Through the keyboard and reader, data is fed, and the result of processing is stored. The input to the system values with field name, data type and width is shown below.

Field Name	*Data Type*
Id	Int
Surname	VarChar(20)
Middlename	VarChar(20)
Sex	VarChar(20)
Date_of_Birth	DateTime
EmployeeNo	VarChar(20)
CompNo	VarChar(20)
MinDeptAgency	VarChar(50)
Rank	VarChar(20)
GradeLevel	VarChar(20)
Gsm	VarChar(20)
LocalGovt	VarChar(20)
StateofOrigin	VarChar(20)
HomeAddr	VarChar(50)
Template	Image

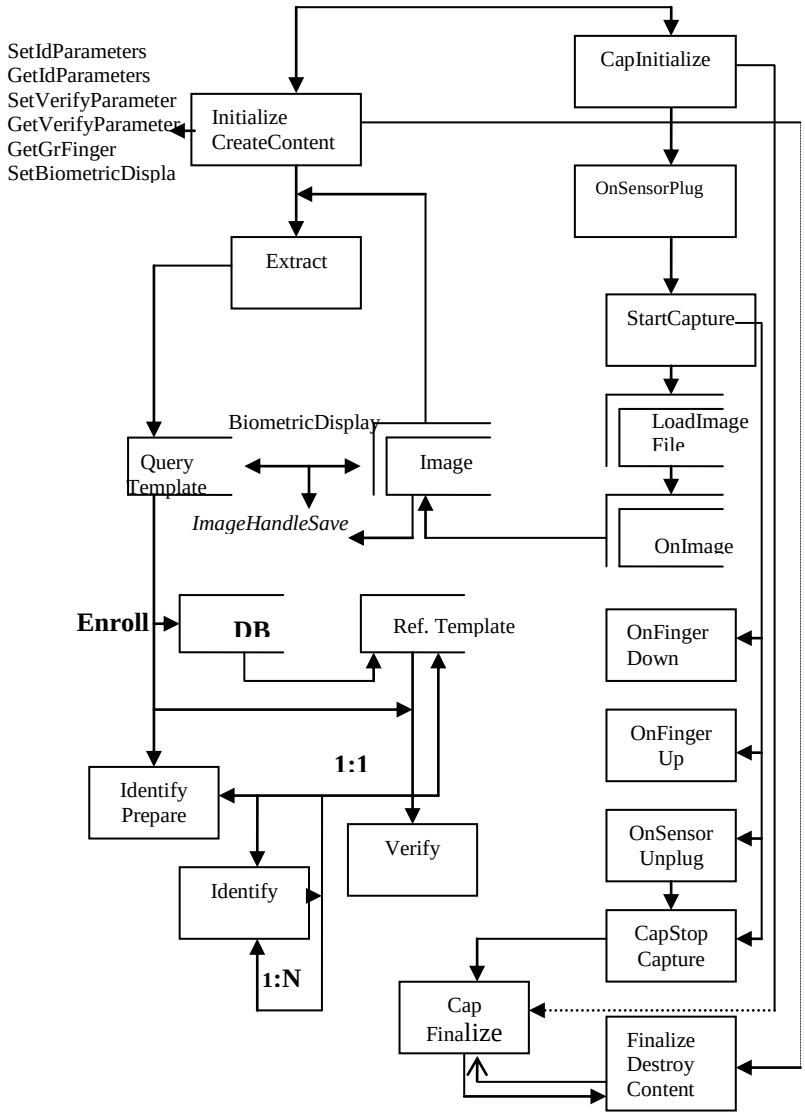


Figure 4, Fingerprint Capture Overview

E. Choice of Programming Language

To design this system the programming language chosen was Visual Basic.Net 2008, also known as VB.Net. The choice of VB.Net was influenced by its flexibility with Windows Operating System and a very good interaction with MS SQL Server 2005. Visual Basic.Net is an object oriented programming language that can create classes and objects using Visual Studio.Net Integrated Development Environment IDE. The IDE normally consists of a source code editor a compiler, build automation tools and a debugger. The Fingerprint SDK ActiveX component is fully supported by the IDE of Microsoft Visual Studio and though most SDKs provide a cumbersome DLL (Dynamic link library) as their unique interface, but it is easy to create import files for the VB.Net.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

V. RESULTS AND DISCUSSIONS

Hence the overall purpose of designing the system is for authentication of the user on presentation of a fingerprint. It therefore implies that the result of verification, of 'accept/reject' the user is a major output expected from the system and display on the log box. This is obtained after all processing activities have been completed, result is written to a log file which can be display on screen or print out.

A. *The GrUtilities Class*

The functions required to handle all GrFinger methods and events are grouped into a single class call grUtilities. For this system design, the main functions are:

- BiometricDisplay used to display images generated by GrFinger.
- ExtractTemplate used to extract the template from acquired image.
- Enroll used to store fingerprint on database.
- Identify used to compare a fingerprint against database content.

The other functions used to manipulate the GrFinger methods and events accordingly:

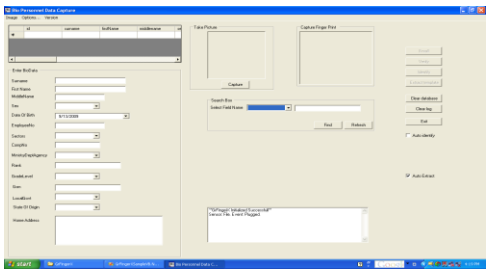
The methods are:

- InitializeGrFinger: prepare Grfingerlibrary to be used.
- FinalizeGrfinger: ends Grfinger library

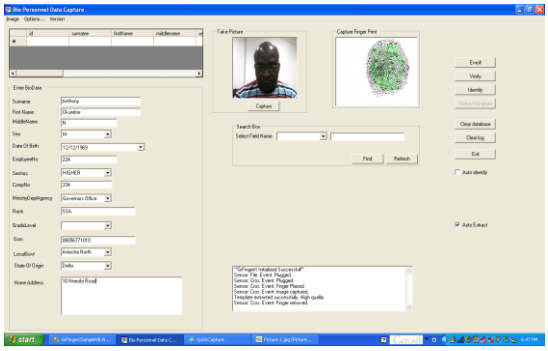
The Events handlers are:

- SensorPlug: triggered when a reader is plugged
- SensorUnPlug: triggered when a reader is unplugged
- FingerDown: triggered when a finger is placed over reader.
- FingerUp: triggered when a finger is removed from reader.
- ImageAcquired: triggered when an image was acquired.
- ImageIsAvailable: triggered when an image was captured and can be processed.
- WriteLog: triggered by each message generated by class.

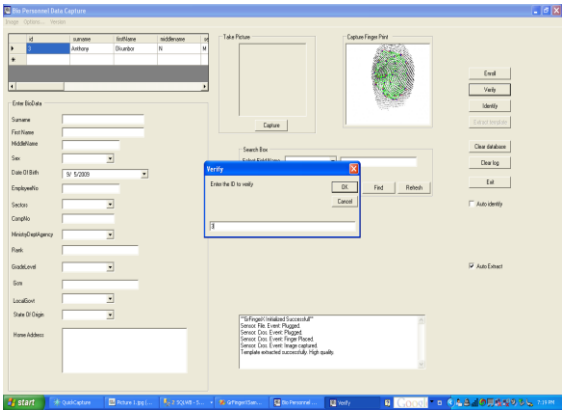
B. *BioPersonnel Data Capture Interface*



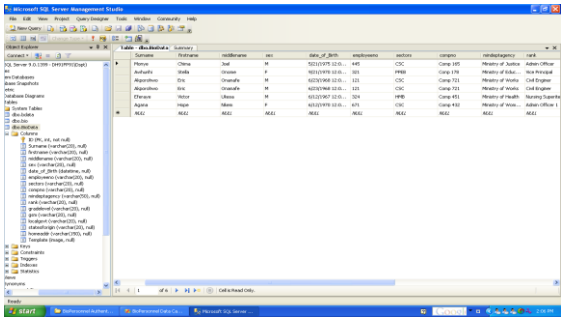
C. *Capture mode*



D. *Verification Mode*



E. *SQL Database Table*



VI. IMPLEMENTATION

The hardware requirements for the implementation of this system are: A. Complete Computer System with configuration: with a minimum Pentium 4, 2Ghz processor; 60 GB Hard Drive space required; 1GB RAM and above; 1074 x 768 Screen resolution monitor; Enhanced Keyboard. Fingerprint Reader is required. The software requirements for the implementation of the system are: Microsoft.Net Framework version 3.5 and above; MS SQL Server 2005 and above, Developer edition; Grfinger SDK; Cross Match device driver/the supported reader driver; Microsoft operating system XP/Vista, Windows 2000 server and above.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

To install the designed application, open the Folder 'BIOPERSONNEL' from D: drive, if is not autorun/or copy the folder to Drive C:

- Double click the folder
- Click on 'BioPersonnel Authenticator' or right click to open
- The program will be initialized.
- Press F5 to executive the application.

Note that the following would have been installed on the system.

- The operating system, the FP SDK (Grfinger dll), MS SQL Server 2005, Visual Studio.net and the Driver of the Reader.

Application Details

The system is user friendly, and easy to use. To make use of this application, the user is expected to login as explained above. On logged on, the Main form is displayed where the user can navigate through the application, noting the following:

- The box on the bottom of the window shows status messages, for example when a reader is plugged or unplugged, a finger is placed over a reader etc.
- By clicking the 'Extract Template' button the last acquired fingerprint image is analyzed and its minutiae and segments are identified, extracted and displayed on screen. But checking the 'Auto Extract' option, whenever a finger is placed over the reader the application will try to automatically extract the minutiae.
- The 'Enroll' button saves the last extracted template into the database and the ID of the enrolled template is displayed in the log box.
- Placing a finger already enrolled in the database over the reader, waiting the image being acquired and clicking the 'Identify' button will perform identification; clicking the 'Verify' button will perform verification. In the latter case the application will ask you the fingerprint ID you want to verify. In both cases the result will be displayed in the log box.
- To delete all the fingerprint enrolled in the database, click the 'Clear database' button.
- To clear the log box, use the 'Clear log button.
- To save the currently displayed fingerprint image to a file, select the option 'Save' in the image menu.
- To load a fingerprint image save in BMP format, select the option 'Load from file' in the image menu.
- Selecting the 'option' menu causes a new window to be opened. In this window it is possible to change the identification and verification thresholds or the fingerprint rotation tolerance, also the colors used to display the fingerprint minutiae, their directions and segments.
- The Threshold is the minimum score needed to state that two fingerprints match. The default value is 45 for the identification process and 25 for the verification process ensuring a 1% FRR

The changeover from the existing system of verifying employees for award of scholarship to the biometric authentication process begins after the system has been installed.

VII. CONCLUSION

As evidenced in the operations of the public sector where paper records of personnel are replicated in many establishments and do not prove effective means for positive identification, giving room for manipulations and embezzlement of funds, fake beneficiaries of scholarship scheme. The biometric technology no doubt offers a more secure automated method to authenticate identity since one cannot loose, forget or share their biometric recognition. Related literatures and overview of the concept was reviewed. The old method was analyzed and the design of the new system takes advantage of the idea to capture biometric data using the fingerprint trait for authentication.

The developed 'BioPersonnel Authenticator' is a successful application in actualizing human pattern recognition. It has features of reliability, flexibility and improved scalability. It is complainant with available industry standard that ensure biometric data interchange and interoperability. It's wide range support of fingerprint readers and template consolidation, improved recognition rate and eliminating the need of using multiple sample of the same finger and outstanding fingerprint matching speed is a major achievement. Further research for the use of biometric system in the organization should be done in the area of multi-biometrics. Also, to improve the actual pattern used for biometric recognition, further research should be conducted regarding algorithm development, template protection, and error rate estimation. The use of Biometrics for the purpose of identification should be encouraged for adoption in the private and public sectors of the economy.

ACKNOWLEDGMENT

Our thanks go to the nameless people who participated in this study and the relevance of the contribution of references consulted is acknowledged.

REFERENCES

[1] Babita Gupta (2008): Biometrics: Enhancing Security in Organizations, E-Government/Technology Series Report 2008, p9, IBM Center for: The Business of Government Washington DC 20005.

[2] Bolle . R, J Connell, S. Pankanti, N. Ratha and A. Senior, (2004): Guide to Biometrics New York: Springer, 2004.

[3] Carrillo, C. M (2003): Continuous Biometric Authentication, a proposed design, Naval Postgraduate School, Monterey, California. P2, p39.

[4] Jain, A. K, Flynn, P. J and Ross, A (2007): Handbook on Biometrics, Springer-Verlag, New York.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

[5] Jain. A and S. Pankanti, (2007): Fingerprint Classification and Matching, http://www.research.ibm.com/ecvg/pubs/sharat-handbook.pdf, January 2007.

[6] Liu, S and Silverman, M (2000): A practical Guide to Biometric Security Technology, IT Professional, IEEE Computer Society Magazine 3 feb (01) p.4.

[7] Maltoni, D., Maio, D., Jain, A.K and Prabhakar, S (2003): Handbook of Fingerprint Recognition, Springer, New York.

[8] Matsumoto, Tsutomu, Hiroyuki Matsumoto, Koji Yamada, and Satoshi Hoshino, (2002): Impact of artificial "gummy" fingers on fingerprint systems, Proceedings of SPIE – Volume 4677, Optical Security and Counterfeit Deterrence Techniques IV, April 2002.

[9] Okumbor A. N (2010) *Fingerprint-Based Biometric Authentication System for Personnel Data Capture*, M.Sc Research Thesis, Dept. of Computer Science, Nnamdi Azikiwe University Awka, Nigeria.

[10] UK Biometrics Working Group, (2001): Use of biometrics for Identification and Authentication: Advice on product selection, November 2001. Retrieved on Oct. 10, 2008 from www.idsysgroup.com/ftp/Biometrics%20Advice.pdf

[11] Woodward, J.D, Orlans, N. M and Higgins, P. T (2003): Biometrics Identity Assurance in the Information Age, Dudley Knox Library Publication 2003, Naval PG School, Monterey CA

[12] Zhang D. (2002): Biometric Solutions for Authentication in an E-world, November 1, 2002.

AUTHORS PROFILE

Author1 Profile … The first Author holds Master of Science M.Sc degree in Computer Science from Nnamdi Azikiwe University, Awka,, Nigeria and MBA from the University of Benin, Benin City, Nigeria. Currently, he is pursuing his Ph.D in Computer Science. His reserch interest is in the study of Biometrics Systems and Biometric-based algorithm and its application. Professionally, he ia a Chartered member of the Computer Professionals Registration Council of Nigeria MCPN, Member Nigeria Computer Society MNCS and Microsoft Certified Professional.

Author 2 Profile … The second Author is the Supervisor. She is an Associate Professor of Computer Science.

A Middleware Platform For Pervasive Environment

Vasanthi.R
Research Scholar , Computer Science and Engineering
Anna University of Technology, Coimbatore
Tamilnadu , India
vasanti_me@yahoo.co.in

Dr. R.S.D. Wahidabanu
Research Supervisor ,
Anna University of Technology, Coimbatore
Tamilnadu , India

Abstract— **The basic goal of pervasive computing is to develop technologies that allow smart devices to automatically adapt to changing environments and contexts, making the environment largely imperceptible to the user. One big barrier to the wide spread development of pervasive computing applications lies in the increased complexity of the programming task. There is a big gap between high-level application requirements, and low-level complex system organization and operations. Middleware can help bridge the gap – supporting rapid development and deployment of applications by domain experts with minimal programming expertise. However, pervasive computing poses new challenges to middleware research. Publish/Subscribe (pub/sub) middleware has many advantages when implementing systems for spontaneous, ad-hoc, pervasive applications. This paper describes REBECA architecture and the REBECA notification service. To efficiently support mobility, it is necessary to adequately deal with the uncertainty introduced by client movement. This paper sketches how this is done in the existing pub/sub middleware with REBECA and shows how to increase the efficiency of logical mobility by adapting the implementation of physical mobility**

Keywords-Middleware;ubiquitous interfaces;publish/ subscribe; REBECA

I. INTRODUCTION

Pervasive computing [1]-[2] is "omni-computing". It is "all-pervasive" by combining open standards-based applications with everyday activities. computing is a rapidly developing area of Information and Communications Technology (ICT). The term refers to the increasing integration of ICT into people's lives and environments, made possible by the growing availability of microprocessors with inbuilt communications facilities. Pervasive computing has many potential applications, from health and home care to environmental monitoring and intelligent transport systems. Pervasive computing systems (PCS) and services may lead to a greater degree of user knowledge of, or control over, the surrounding environment, whether at home, or in an office or car. They may also show a form of 'intelligence'.

Mark Weiser has been named as the father of ubiquitous computing (Ubicomp) and has presented his vision[3] in the following way: "Ubiquitous computing has as its goal the enhancing computer use by making many computers available throughout the physical environment, but making them effectively invisible to the user." In his another paper [1] Weiser predicts that there will be quite commonly hundreds of computers in one a room but by then they are so small and commonplace that they are virtually invisible to users.

Pervasive computing is the third wave of computing technologies to emerge since computers first appeared:

- First Wave - Mainframe computing era: one computer shared by many people, via workstations.
- Second Wave - Personal computing era: one computer used by one person, requiring a conscious interaction. Users largely bound to desktop.
- Third Wave - Pervasive (initially called ubiquitous) computing era: one person, many computers. Millions of computers embedded in the environment

A. What Is Middleware?

Any piece of software that glues together various other pieces of software can be labeled as middleware [5]-[6]. The two most common functions handled by middleware solutions are messaging and data access services. A typical usage scenario is one where a graphical user interface (GUI) component needs to access a remote database. Usually the GUI part has to be independent of the actual database implementation and a middleware component or a set of middleware components provide that functionality to the GUI. Thus middleware provides a service layer in the software architecture that separate the details of implementation from users of middleware in Fig.1. The typical users of middleware are application developers who build new applications to be deployed in the target environment.

Other typical middleware services include message passing, transaction monitoring, directory lookup and object brokerage or other distributed computing environment services. Many of the middleware solutions in use today are application- specific or optimized for a set of applications but naturally there are also generic middleware solutions [4]. Examples of current generic-purpose middleware solutions are CORBA(Common Object Request Broker Architecture), DCOM (Distributed Common Object Model), J2EE (Java 2 Enterprise Edition), J2ME (Java 2 Micro Edition) and WAE (Wireless Application Environment).Of these only J2ME and WAE are intended to be used on mobile devices. The remaining three are still suitable for server-side computing but they don't adapt well to

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

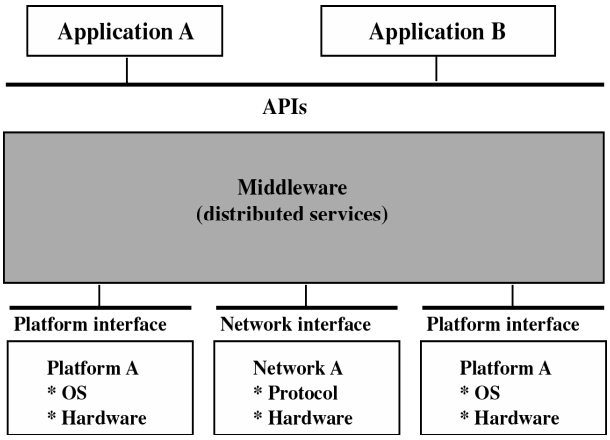


Figure 1

more challenging requirements of pervasive computing like automatic reconfiguration and service discovery or context-awareness on the device.

B. Pervasive computing technologies

Pervasive computing involves three converging areas of ICT[3]:computing('devices'),communications ('connectivity') and 'user interfaces'.

1)Devices

PCS devices are likely to assume many different forms and sizes, from handheld units (similar to mobile phones) to near-invisible devices set into 'everyday' objects (like furniture and clothing). These will all be able to communicate with each other and act 'intelligently'.

Such devices can be separated into three categories:

- sensor :input devices that detect environmental changes user behaviors, human commands etc;
- processor :electronic systems that interpret and analyze input-data;
- actuator :output devices that respond to processed information by altering the environment via electronic or mechanical means.

For example, air temperature control is often done with actuators. However the term can also refer to devices which deliver information, rather than altering the environment physically. There are many visions for the future development of PCS devices. The idea is that each one would function independently, with its own power supply, and could also communicate wirelessly with the others.

2)Connectivity

Pervasive computing systems will rely on the interlinking of independent electronic devices into broader networks. This can be achieved via both wired (such as Broadband (ADSL) or Ethernet) and wireless networking technologies (such as Wi-Fi or Bluetooth), with the devices themselves being capable of assessing the most effective form of connectivity in any given scenario. The effective development of pervasive computing systems depends on their degree of interoperability, as well as on the convergence of standards for wired and wireless technologies.

3)User interfaces

User interfaces represent the point of contact between ICT and human users. For example with a personal computer, the mouse and keyboard are used to *input* information, while the monitor usually provides the *output.* With PCS, new user interfaces are being developed that will be capable of sensing and supplying more information about users, and the broader environment, to the computer for processing. With future user interfaces the input might be visual information – for example recognizing a person's face, or responding to gestures. It might also be based on sound, scent or touch recognition, or other sensory information like temperature. The output might also be in any of these formats. The technology could 'know' the user (for example through expressed preferences, attitudes, behaviors) and tailor the physical environment to meet specific needs and demands.

C. Networks of Pervasive Computing

Pervasive computing devices can be connected to each other using three types of networks. Wireless Wide Area Networks use typically digital cellular radio technologies from the end user devices to base stations. Short-range Wireless technologies can be used typically indoors since the range is usually just a few tens of meters. The third type of networks can be found at residential and office environments where they connect controls and appliances.

D. Classification Of The Ubiquitous Middleware

Several ubiquitous middleware architectures and infrastructures have been introduced in the academic and industrial world. The current middleware treat ubiquity from slightly different perspectives. We distinguish various middleware technologies[6],[8] ranging from partially integrated middleware to fully-integrated middleware. We mean by fully-integrated middleware, middleware providing key elements for all applications requirements such as discovery, adaptation/composition, context management, and management of ubiquitous applications. In this category we cite ubiquitous middleware systems such as Aura, Gaia, Oxygen, Pcom , and One.world. Partially-integrated middleware range from platforms that were specially realized to handle one or two ubiquitous requirements, such as the application discovery in Jini and UPnP, to platforms that are being extended to ubiquity for the application management such as OSGi and .Net Framework . We survey the current state-of-the-art architectures from the viewpoint of the core requirements identified above. In this survey, we will highlight the most known and used fully and partially-integrated middleware. We will not deal with the platforms that are being extended to ubiquity as these

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

extensions are still in a preliminary state. Later on, a classification will focus on the strength and weakness of each of the ubiquitous middleware, based on the identified requirements.

1)Aura

Aura[9] provides user with an invisible halo of computing and information services that persists regardless of location. A personal Aura acts as a proxy for the mobile user it represents. Aura aim is to allow users to execute their tasks regardless their location. It allows users to dynamically realize daily tasks modeled as abstract software applications, in a transparent way, without manually dealing with the configuration and reconfiguration issues of these applications. Aura deals more with adaptation, replacement of services, the dynamic configuration and reconfiguration of user tasks. Project Aura provides several pervasive applications adapted to both homes and offices.

2)Gaia

Gaia[10] is a services-based middleware that integrates resources of various devices. It manages several functions such as forming and maintaining device collections,
sharing resources among devices and enables seamless service interactions. It also provides an application framework to develop applications for the device collection. The application framework decomposes the application into smaller components that can run on different devices in this collection. The notion of ad-hoc pervasive computing in Gaia is a cluster of personal devices that can communicate and share resources among each other. The cluster is referred to as a personal active space. The user can program this cluster through a common interface. Mobile Gaia role is to provide services that discover devices that form the personal space, maintain the composition of the cluster, share resources among devices in the cluster and facilitate communication. Similarly to Aura, Gaia focuses on the dynamic aspect of ubiquitous environments and provides the support for dynamically mapping applications to available resources of a specific active space.

3)Oxygen

Oxygen[11] vision is to bring an abundance of computation and communication within easy reach of humans through natural perceptual interfaces of speech and vision. Computation blends into peoples' lives enabling them to easily do tasks they want to do, collaborate, access knowledge, automate routine tasks and their environment. In other words, it enables a pervasive, human centric computing. The approach focuses on four technological areas: embedded computational devices, handheld devices, networks, and also on adaptive software. Perception is a central issue, however the focus is mainly on vision and speech aiming to replace explicit traditional input mechanisms with conversational and gesture input.

4)One.world

One.world[12] is a system architecture for ubiquitous computing. It provides an integrated, comprehensive framework for building pervasive applications. The One.world architecture builds on four foundation services. First, a virtual machine provides a uniform execution environment across all devices and supports the ad hoc composition between applications and devices. Second, tuples define a common type system for all applications and simplify the sharing of data. Third, events are used for all communications and make change explicit to applications. Applications are composed from components that exchange events through imported and exported event handlers. Events make change explicit to applications, with the goal that applications adapt to change instead of forcing users to manually reconfigure their devices and applications. Finally, environments host applications, store persistent data, and through nesting facilitate the composition of applications and services.

5)Pcom

Pcom[13], a Component system for ubiquitous computing is a light-weight component system that offers application programmers a high-level programming abstraction which captures the dependencies between components using contracts. Pcom allows the specification of distributed applications that are made up of components with explicit dependencies modeled using contracts. Pcom relies on a communication middleware,

6) Base

Base is a flexible middleware for Pervasive computing environments. It provides adaptation support on the communication level by dynamically selecting or reselecting communication protocol stacks, even for currently running interaction. Base is written in Java using the Java 2 Micro Edition with the Connected Limited Device Configuration. It assists application programmers by providing mechanisms for device discovery and service registration that can be used to locate and access local as well as remote device capabilities and services. It also provides a simple signaling mechanism to determine the availability of these devices and services.

7)Jini

Jini [14] is a Java-based architecture for spontaneous networking. Participants in a Jini community require no previously knowledge of each other, and can take full advantages of the dynamic class loading and type-checking of the Java language, which requires a Java virtual machine (JVM) for all participants. A Jini community is established around one or more Lookup Services, which organize the services deployed in the community and respond to requests from clients. The Lookup service is itself a Jini service, acting as a bootstrapping service. References to these Lookup services are obtained either by unicast or multicast discovery protocols defined by Jini. The main idea of Jini for supporting “spontaneous networking” is achieved by a leasing principle, which means that services are leased into the community.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

When a service provider registers a service in the Lookup service it obtains a lease, which must be renewed before it expires, otherwise the Lookup service automatically de-register the service. Clients can register for changes in the Jini community, such as new, discarded, or changed services, using remote event registrations. By the same principle clients and service providers can register for events of new or discarded Lookup services. Event registrations are leased in the community, so automatic cleanup can be initiated for non-responding clients. These are the real benefits of Jini, enabling opportunity to create a self maintaining ubiquitous computing.

8) UPnP

UPnP [15] technology defines an architecture for ubiquitous peer-to-peer network connectivity of intelligent appliances, wireless devices, and PCs of all form factors. It is designed to bring easy-to-use, flexible, standards-based connectivity to ad-hoc or unmanaged networks whether in the home, in a small business, public spaces, or attached to the Internet. UPnP technology provides a distributed, open networking architecture that leverages TCP/IP and the Web technologies to enable seamless proximity networking in addition to control and data transfer among networked devices. It is designed to support zero-configuration, "invisible" networking, and automatic discovery for a breadth of device categories from a wide range of vendors. A device can dynamically join a network, obtain an IP address, convey its capabilities, and learn about the presence and capabilities of other devices. A device can leave a network smoothly and automatically without leaving any unwanted state behind.

We propose a classification of the previously mentioned ubiquitous middleware. The classification was established upon the challenges raised by ubiquitous computing and upon how the various ubiquitous middleware respond to them. Fig. 2 classifies the existent ubiquitous middleware defined above using the requirements of ubiquitous middleware. For each middleware technology, we focused on the requirements it respects and the ones it does not fulfill. If some requirements are relatively well fulfilled by nowadays systems, such as discoverability, context awareness and adaptability, others are far from being fulfilled or even dealt with such as security, interoperability scalability and autonomous management.

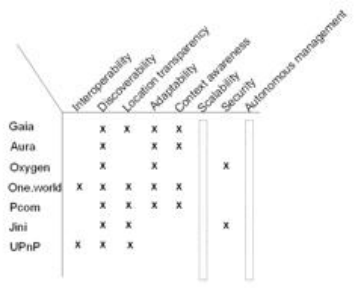


Figure 2 Classification of ubiquitous middleware

II. The Need for a Common Platform

Computing devices already cover a wide range of platforms, computing power, storage capacity, form factors, and user interfaces. We expect this heterogeneity to increase over time rather than decrease, as new classes of devices such as pads or car computers become widely used. Today, applications are typically developed for specific classes of devices or system platforms, leading to separate versions of the same application for handhelds, desktops, or cluster-based servers. Furthermore, applications typically need to be distributed and installed separately for each class of devices and processor family. As heterogeneity increases, developing applications that run across all platforms will become exceedingly difficult. As the number of devices grows, explicitly distributing and installing applications for each class of devices and processor family will become unmanageable, especially in the face of migration across the wide area.

For a single application programming interface (API) and a single binary distribution format, including a single instruction set, that can be implemented across the range of devices in a pervasive computing environment. A single, common API makes it possible to develop applications once, and a single, common binary format enables the automatic distribution and installation of applications. It is important to note that Java does not provide this common platform. While the Java virtual machine is attractive as a virtual execution platform (and used for this purpose by *one.world*), Java as an application platform does not meet the needs of the pervasive computing space. In particular, Java's platform libraries are rather large, loosely integrated, and often targeted at conventional computers. Furthermore, Java, by itself, fails to separate data and functionality and does not encourage programming for change. Given current hardware trends and advances in virtual execution platform, such as the Java virtual machine or Microsoft's common language runtime. We can reasonably expect that most devices can implement such a pervasive computing platform. Devices that do not have the capacity to implement the full platform, such as small sensors, can still interact with it by using proxies or emulating the platform's networking protocols.

Furthermore, legacy applications can be integrated by communicating through standard networking protocols, such as HTTP or SOAP , and by exchanging data in standard formats, such as XML. A pervasive computing platform that runs across a wide range of devices does impose a least common denominator on the core APIs. Applications can only assume the services defined by the core APIs; they must implement their basic functionality within this framework. At the same time, a common platform does not prevent individual devices from exposing additional services to applications. It simply demands that additional services be treated as optional and dynamically discovered by applications. All system interfaces are asynchronous, and application components interact by exchanging asynchronous events.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

A. Challenges of Middleware

Weiser identified nearly a decade ago several research areas for Ubicomp from the different fields of computer science and many of them have been solved. The place of "IP middleware" and Wireless Middleware have been defined but what is exactly inside them is still an open research issue. Since it is highly improbably that there will be a single dominant middleware platform there is a clear need for interoperability. The paper identifies two levels of interoperability: "between middleware platforms and between parts of an application running on different middleware platforms" in Fig. 3.

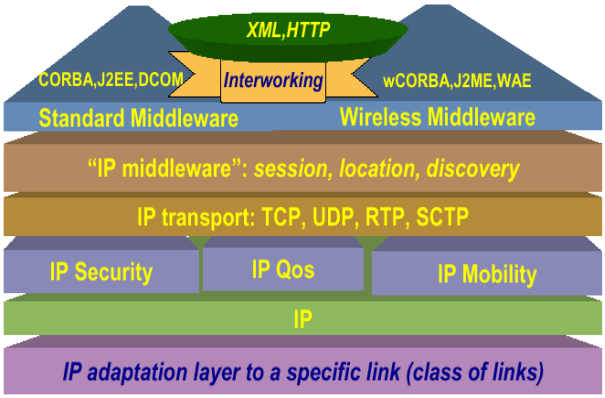


Figure 3. Layered architecture of middleware and Internet protocols

Ubiquitous computing expects a mobile user to be embedded into surroundings filled with communicating and interacting artifacts , all serving the spontaneous needs of the user. Moreover, interaction between users and the surroundings in highly mobile and dynamic settings has to be mediated by a common middleware platform[16],[17], together with personalized devices and specialized services, facilitating the needs of mobile users. This basic system model of nomadic users and smart infrastructures poses a number of challenges for such middleware support.

First of all, mobility by itself requires different paradigms for interaction than those found in classical distributed systems. Many paradigms, well-established in static distributed systems are likely to fail when applied to these new settings. One prominent example among many is the request/reply paradigm, which is too static and tight-coupled to be successful in dynamic mobile settings. Here, different paradigms, like loose-coupling and data-centric computing, are more likely to succeed.

The next challenge for middleware is to support mobile applications to react "smartly" to changes of their execution environment. Users of such applications obviously expect their electronic helpers to adapt themselves to the current situation they are used in. A well-known example is to turn off the ringer tones of a mobile phone when the user is in a meeting situation. Such adaptation is part of what usually is called context- or situation-aware computing. The challenge for middleware support lies here in providing means to retrieve context information from the environment on a syntactic and semantic level. Here we face issues of heterogeneity, together with efficient filtering of large volumes of information available.

Another challenge for middleware support in dynamic and mobile scenarios is the need to decouple producers and consumers of data in the system in *time* and *space*.. Effective means for anonymous interaction are therefore essential. Moreover, for mobile clients the receiver cannot be assumed to be online at the same time the sender produces the data. Again, a middleware solution can provide facilities for buffering and access to past information.

The scale of pervasive systems we envision is also a challenge. On the one hand, systems will grow in physical size, like spanning a whole city. On the other hand, systems also can be rather small in size, but dense in the number of processors and applications contained within. Thus, the key challenge is to provide a communication infrastructure in which data and information is still manageable even for small devices while communication remains efficient and scalable.

This constitutes a strong demand for a mediator *between* producers and consumers of data, i.e., a middleware solution to the challenges listed above using mechanisms that are based on a publish/subscribe notification service with Rebecca model.

B. Requirement analysis

Among the requirements, the need for proper support for mobility and environment awareness is of outstanding importance. Moreover, we compare several different communication paradigms for distributed systems to identify one which will serve best as the basis for extensions needed in pervasive systems. We identify the well-established publish/subscribe paradigm as a suitable basis for such extensions.

1)Mobility support

This is a common requirement for clients of the infrastructure that roam freely. Certain aspects of the handling of this issue are located in the infrastructure and are opaque to the client. This can be beneficial for a client either because it is not aware of its own mobility, e.g., together with legacy applications, or deliberately wants to delegate some aspects into the infrastructure. Therefore, devised a relocation algorithm that facilitates location transparency, offering the possibility to transfer existent event-based applications seamlessly into mobile environments[18]. The algorithm extends the existing content-based routing infrastructure to support non-interrupted, sender-FIFO ordered delivery of notifications in the mobile case, without having a client even to be aware of this extension.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

2) Location-dependent subscriptions and notifications.

First, most information can be related to some location and next, we need strong selection criteria to distinguish relevant from irrelevant information. However, to make *location* usable together with a content-based publish/subscribe notification service, we introduced a special location model. It serves as the foundation for location-dependent subscriptions and notifications, respectively. The challenge from the point of view of the publish/subscribe infrastructure is two fold: first, hiding the details and burdens of adaptation of location-dependent subscriptions to the current position of a client. Second, due to the uncertainty of the client position and movement, to keep delivery of information timely and accurate and to keep the network load for the client bearable.

3) Decoupling in space and time.

To a large degree the previous solutions, together with the basic publish/subscribe paradigm, already decouple sender and recipient of data in space and time. This can be done by virtually relocating the arrival time of a client at a new location into the past. Hence, we establish distributed buffers in the infrastructure together with a set of search and consolidation strategies, tailored to minimize the bootstrapping latency experienced by a client.

4) A framework for the development of context-aware applications

We identify *context* to be an important input for applications in pervasive computing systems. Usually, such context data is the result of changes in the volatile external computing environment the client operates in. Adaption therefore is reactive in nature. Some aspects of the framework resemble mechanisms also found in the rather recent paradigm of *model driven development* (MDD).

C. Publish/subscribe systems for pervasive computing

The publish/subscribe [19] communication paradigm is increasingly used in many application domains and areas of computer science. It allows processes to exchange information based on message type or content rather than particular destination addresses. Information about some event is published via notifications, which are conveyed by the underlying pub/sub notification service. A consumer registers its interest in certain kinds of notifications by issuing subscriptions, and it gets notified by the notification service about any newly published notification that matches at least one of its subscriptions. The loose coupling of producers and consumers is the prime advantage of pub/sub systems in Fig. 4. and has many applications in the context of spontaneous, ad-hoc and pervasive environments.

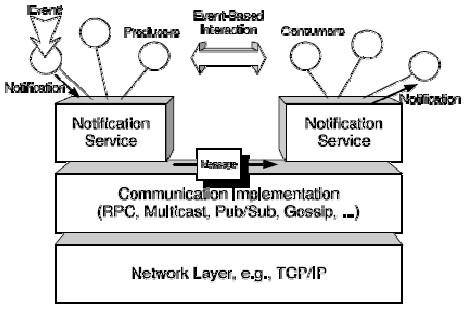


Figure 4. Publish/Subscribe System

Publish/Subscribe (pub/sub): a powerful abstraction for building distributed applications such as Message-based, anonymous communication , Participants are decoupled

Pub/Sub is well suited for mobile systems

- Proliferates loose coupling
- Leverages reconfigurability and evolution
- Efficient support for many to many communication
- No explicit knowledge about participating parties necessary

D. Mobility support in pub/sub middleware

One major characteristic of pervasive applications is mobility. However, up to now research is mainly focused on using pub/sub middleware in rather static, non-mobile environments, i.e., systems where clients (producers and consumers) do not roam and the infrastructure itself stays rather fixed or is only changing slowly during the system's lifetime. Consequently, most pub/sub infrastructures (e.g., SIENA, JEDI , REBECA, to name a few) have optimized algorithms for information delivery in those settings. Support and optimizations for mobile clients are not built-in features of the infrastructure; it is left to the applications to adapt or reissue subscriptions. Publish/subscribe pub/sub) proliferates loose coupling and is touted to facilitate mobility. The inherent loose coupling even allows existing applications to be transferred to mobile environments, if an appropriate infrastructure support is available. However existing pub/sub middleware are mostly optimized for static systems where users as well as the underlying system structure is rather fixed. In this paper we analyze the necessary steps to support mobile clients with publish/subscribe middleware. The REBECA content-based pub/sub service is extended to accommodate to physically mobile clients, offering a location transparent access to the middleware without degrading the previously guaranteed quality of service. The transparent access allows existing applications to be seamlessly transferred from a static to a mobile scenario without having to adapt client applications.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

E. Location transparency and physical mobility

A first step towards mobility is to enhance existing pub/sub middleware to allow for roaming clients so that existing applications can be used in mobile environments. This means that the interfaces for accessing the middleware and the applications on top are not required to change. More importantly, the quality of service offered by the middleware must not degrade substantially. Generally speaking, location transparency is what makes existing applications mobile, e.g., stock quote monitoring can be seamlessly transferred from PCs to PDAs. Location transparency is the main aspect of what is called physical mobility.

F. REBECA Model

Basically, the architecture is centered around a distributed network of communicating notification brokers. Because of its distributed nature, REBECA[20] is a representative example of a distributed notification service like SIENA, JEDI, etc. REBECA supports different routing algorithms and data and filter models. The role of the Rebeca notification service is to decouple sender and recipient of notification messages. This is done in a transparent way for clients Rebeca supports different routing algorithms and data and filter models**.** The original architecture of Rebeca in Fig. 5 was designed for scalability and notification routing optimizations. To add extension to this basic model for proper support of mobile and pervasive applications and leave the basic functionality and properties untouched where possible for the structure of the broker network, besides the characteristic of being an overlay network, three types of brokers can be distinguished: local, border, and inner brokers.

1) Local broker

Local brokers act as access points to the infrastructure. Typically, they are part of an application's communication library and are loaded on application startup. Thus, they cannot be handled as regular part of the broker network and they do not show in the actual graph structure of the notification service. A local broker is connected to a single border broker.

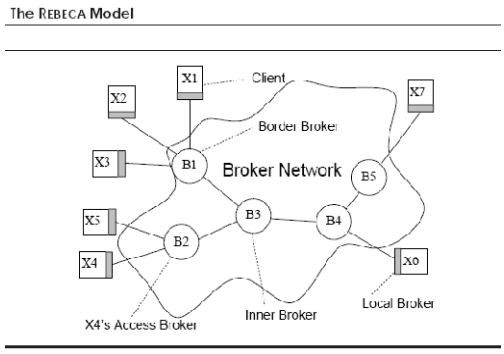


Figure 5. Router network of Rebeca

2)Border broker

Border brokers are always the first "hop" into the network of brokers and form the boundary of the routing network. Border brokers play a major role for supporting and hosting mobile clients, as well as maintaining caches and connections to their local brokers.

3) Inner broker

Inner brokers are connected to other inner or border brokers and do not maintain any connections to clients.

G. Notification delivery with roaming clients

Introduce an algorithm for extending standard REBECA brokers to cope with mobile clients, maintaining their subscriptions as well as guaranteeing the required quality of service

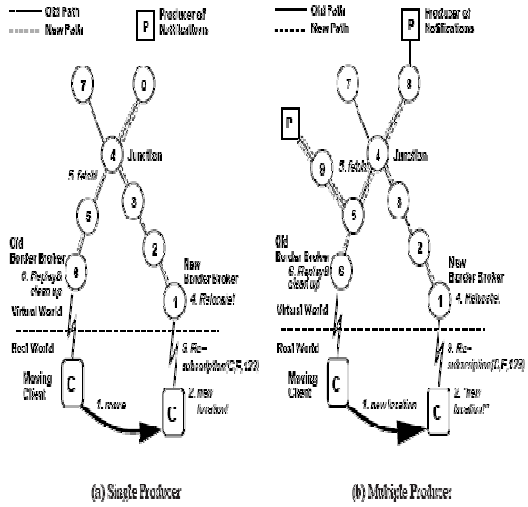


Figure 6. Moving client scenarios with one and multiple producers

1)Algorithm phases

The routing network of REBECA was extended to implement an algorithm consisting of three distinct phases, propagation, fetch, and relocation. Using exclusively the publish / subscribe paradigm together with the distributed broker network, each phase has a separate goal.

PROPAGATION

The goal of the propagation phase is basically twofold. In the above Fig. 6(a) one can see that, after a client is reconnecting to a different broker, a new path to one or more producers of requested data must be set up. However, due to the special structure of the broker network this path is meeting the old delivery path at some point. We call this particular broker the junction broker. By identifying the junction where old and new path meet, the propagation phase is finished and a new delivery path is set up.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

FETCH

After the identification of the junction a special fetch message is sent along the old delivery path, with the goal of shutting down the old delivery path and, more importantly, identifying which part of the old delivery path can be discarded and which part has to be redirected. This is the case in a multiple producer example as shown in Fig. 6(b). After the fetch message reaches the border broker of a relocating client C, the second phase terminates.

a) Relocation

The last phase is the actual relocation of cached messages for client C. A standard replay message as already being part of REBECA is used to sent messages from the old location to the new location.

An additional goal is to "garbage-collect" those parts of the old delivery path between junction and border broker not used anymore for message delivery. The replay is propagated along the old delivery path in the direction of the junction, from there it is sent along the new path to the new location of Client C where old notifications are delivered to the client eventually. After termination the effect of the algorithm is that a relocating client effectively has bridged phases of disconnected operation, without losing notifications and with almost the same delivery guarantees as in the non-mobile case.

2) Algorithm Overview

a) Basic Support of Mobility

Build an algorithm which is useful for

- "Legacy" applications
  - Already deployed
  - Unaware of mobile environments and problems involved
    - (Sudden) disconnectedness
    - Message delays
    - Uncertainty of movements
    - Transparency needed!
- "Mobility-aware" applications
  - Delegation of mobility-handling into "network layer"
  - Transparent relocation protocol

b) Basic Algorithmic details

- Install and maintain (local) buffers in border brokers
- Buffer notifications N for client C at broker B1 until:
  - Reconnection) client C reconnects to B1 and delivery
  - resumes normally
  - (Roaming) client C reconnects to B2 and buffer N must be relocated to B2
  - (Exception) Client C "disappears": maintain buffer until timeout reached (fallback behavior)
- Client must re-issue subscriptions at (potential) new locations (case 1 and 2 above)
  - Location model is external/customizable
  - Transparent for the applications
  - Explicit MoveIn (Join) operation at new location
  - Implicit MoveOut or (Leave) (eventually) at old location (Garbage Collection)

c) Details

- Phase 1: subscription propagation
  - Brokers forwards subscriptions towards producers
  - Delivery for a mobile client is delayed at border broker
- Phase 2: junction Broker
  - Has seen the subscription
  - Initiates Phase 3
  - Starts routing towards Client C
- Phase 3: fetch
  - New type of inter-broker message
  - Sent along the "old" delivery path
  - Works as "closing tag" for this path/client
    - Needed for consistency!
    - No in-transit notifications are lost
- Phase 4: replay
  - "Old" Broker has buffered all notifications once a connection loss is detected
  - Sends a "replay" towards the junction, the
  - junction forwards it to "new" broker
  - Garbage collection
- Phase 5: de-allocation
  - routing entries on "old" path are deleted (if necessary)
  - Can be complicated in multiple-producer scenarios
- Phase 6: FIFO and event delivery
  - "New" broker simply prepends old to new notifications
  - Delivery in correct order (sender FIFO) to client

III. RELATED WORK

A. Conventional Middleware Systems

Device heterogeneity is not a unique characteristic of pervasive computing, but can be found in conventional systems, too. Different middleware systems like CORBA, Java RMI or DCOM have been developed, to provide a homogeneous access to remote entities independent of e.g. operating systems or hardware architectures. Typically, these middleware systems try to provide as much functionality as possible, which leads to very complex and resource consuming systems, that are not suitable for small devices. Approaches to solve this problem exist and are discussed below. Conventional middleware systems are designed for mostly stable network environments, in which service unavailability is a rare event and can be treated as an error.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

B. Dynamically Reconfigurable Middleware Systems

Extending conventional middleware systems to dynamically reconfigurable middleware systems, enables such middleware to adapt its behavior at runtime to different environments and application requirements, e.g. how marshalling is done. Still, different communication models or different protocols for outgoing and incoming messages are typically not supported. As one exception, the Rover toolkit provides this functionality for its queued RPC (QRPC) concept, layered on top of different transport protocols. However, Rover only supports the QRPC and addresses potentially disconnected access to an infrastructure and not spontaneous networking. A further difference from BASE is that most existing reconfigurable middleware systems concentrate on powerful reconfiguration interfaces and not on supporting small, resource-poor devices. A notable exception to this is UIC , which is discussed below.

C. Middleware for Resource-Poor Devices

The resource restrictions on mobile devices prohibit the application of a full-fledged middleware system. One way to address this is to restrict existing systems and provide only a functional subset leading to different programming models or a subset of available interoperability protocols. Another option is to structure the middleware in multiple components, such that unnecessary functionality can be excluded from the middleware dynamically. One example is the Universally Interoperable Core (UIC). UIC is based on a micro-kernel that can be dynamically extended to interact with different existing middleware solutions. Still, the used protocol stack is determined before the start of the interaction and cannot be switched between request and reply as in BASE and abstractions are only provided for remote services. Most recent research efforts of middleware are shown in the table 1.

Table 1 Recent Research effects

Projects	*Key Issues*
UIC	Heterogeneity of devices and networks: It helps users to specialize to the particular properties of different devices and network environments
RCSM	Context awareness in applications during development and runtime operation: It combines the characteristics of context awareness and ad hoc communications in a way to facilitate running complex applications on devices
X-Middle	Disconnected operations in mobile applications: It allows mobile users to share data when they are connected, or replicate the data and perform operations on them off-line when they are disconnected; data reconciliation takes place when user gets reconnected
Gaia	Dynamic adaptation to the context of mobile applications: It supports the development and execution of portable applications in active spaces
Environment Awareness Notification Architecture	Scarce resources of mobile devices and dynamicity of the mobile environment: It models the environment as an asynchronous event that includes the information related to the change
Nexus	Heterogeneity in networks: It provides an infrastructure that supports communication in heterogeneous network environments
Lime	Programming constructs which are sensitive to the mobility constraints: It explores the idea by providing programmers with a global virtual data structure and a tuple space (Tspace), whose content is determined by the connectivity among mobile hosts
Tspaces	Asynchronous messaging-based communication facilities without any explicit support for context-awareness: It explores the idea of combination of tuple space (Tspace) and a database that is implemented in Java. Tspace targets nomadic environment where server contains tuple databases, reachable by mobile devices roaming around
L2imbo	QoS monitoring and control by adapting applications in mobile computing environment: It provides the facilities of multiple spaces, tuple hierarchy, and QoS attributes
Aura	Distraction-free pervasive computing: It develops the system architecture, algorithms, interfaces and evaluation techniques to meet the goal of pervasive computing

IV.CONCLUSION

This paper started with introduction and discussion of pervasive computing and middleware and how they are connected to each other. The traditional middleware solutions however have been designed for a complete different operating environment than where pervasive devices of today and tomorrow will live so they are not suitable solutions without (radical) modifications. Ubiquitous middleware are becoming the nowadays trend in the development of ubiquity in computer science fields. Ubiquitous applications rely upon this layer, to profit from the diverse functionalities it has to offer. Ubiquitous environments brought more constraints and challenges to mobile environments. The main constraints come from, the environment's heterogeneity and dynamics, and the variable connectivity of the devices coming and leaving. The main challenges are in maintaining the computing smartness, scalability, invisibility and pro-activity for the users in these environments. The functionalities offered

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

by middleware need to cope with these challenging nature of environments. We sorted the middleware in two groups. The fully-integrated ones, provide functionalities such as discovery, adaptation/composition, and context management. The partially-integrated ones, provide one or two of these functionalities, as they were specifically developed for a specific purpose. We classified these middleware, by analyzing if they are interoperable, discoverable, adaptable, context aware, scalable, secure and autonomous. If many of these middleware are mature enough and offer specific functionalities respecting the properties of ubiquity, a real lack is noticed in having an interoperable, autonomous and scalable middleware for the execution of ubiquitous applications. The development of the service-oriented paradigm, the semantics and the Web middleware shows the new trend the middleware research field is engaged in. At the other hand the intersection of this research field with artificial intelligence and autonomic computing leads to the development of the ambient intelligence, the future evolution of ubiquitous computing.

The ultimate purpose of the middleware is to ease the development of the end user applications. Many middleware technologies are quite complex to use and maintain plus expensive to obtain. The already mentioned interoperability remains to be a problem, which is usually solved by writing application for just one platform, or pair of platform that are a "natural fit" to each other. For the application architect today the most important issue to solve during the design phase of a new application is how connect the mobile device to back-end servers. There is no one correct solution to that question since no middleware solution cannot satisfy all of these three tough requirements: "very efficient, very adaptable and very scalable" at the same time.

V. REFERENCES

[1] Mark Weiser, The computer for the 21st Century. Scientific American, Sept. 1991

[2] D.Saha and A.Mukherjee, Pervasive Computing :A paradigm for the 21st century. IEEE Computer Magazine, Mar 2003

[3] Mark Weiser, Ubiquitous computing, IEEE Computer ,1993

[4] Guruduth Banavar and Abraham Bernstein "Software infrastructure and design challenges for ubiquitous computing applications", Commun. ACM, Vol. 45, pp. 92-96,December 2002.

[5] Qusay H.Mahmoud , Middleware for communication, John Wiley & Sons,2001

[6] Bernstein Philip A., Middleware, Communication of the ACM, vol. 39, no 2,pp 86–98 ,Feb 1996

[7] Gregory D. Abowd, and Elizabeth D. Mynatt "Charting past, present, and future research in ubiquitous computing", ACM transactions on Computer-Human Interaction, Vol. 7, pp 29–58, March 2000

[8] Judith M.Myerson, The complete book of middleware , CRC PR I LLC,2002

[9] Garlan, D., Siewiorek, D., Smailagic, A., Steenkiste, P," Project Aura: Towards distraction-free pervasive computing" IEEE Pervasive Computing, special issue on"Integrated Pervasive Computing Environments", 21(2):22-31, 2002

[10] Chetan, S., Al-Muhtadi, J., Campbell, R., Mickunas, M.D. , "Mobile Gaia: A Middleware for Ad-hoc Pervasive Computing" , IEEE Consumer Communications & Networking Conference, Las Vegas, USA. 2005.

[11] Rudolph, L. , " Project Oxygen: Pervasive, Human-Centric Computing - An Initial Experience" Advanced Information Systems Engineering, 13th International Conference (CaiSE2001), LNCS 2068, 765—780, Interlaken, Switzerland,2001

[12] Grimm, R. ," One.World: Experiences with a Pervasive Computing Architecture". IEEE Pervasive Computing, 3(3): 22-30 ,2004

[13] Becker, C., Handte, M., Schiele, G., Rothermel, K. , " PCOM – A Component System for Pervasive Computing" 2nd IEEE Annual Conference on Pervasive Computing and Communications, Washington, DC, USA,2004

[14] Kumaran, S., I. , "JINI Technology An Overview" , Prentice Hall PTR,2002

[15] UPnP forum ," UPnP Technology – the simple, seamless home network", whitepaper,2006

[16] Salem Hadim , Nader Mohamed ," Middleware Challenges and Approaches for Wireless Sensor Networks", IEEE DISTRIBUTED SYSTEMS ONLINE 1541-4922 , IEEE Computer Society Vol. 7, No. 3; March 2006.

[17] S. Hadim and N. Mohamed , "Middleware for Wireless Sensor Networks: A Survey," in Proc. 1st Int'l Conf. Comm. System Software and Middleware (Comsware 2006), IEEE CS Press, 2006.

[18] Satyanarayanan. M, Pervasive computing: Vision and challenges IEEE Personal Communications, vol. 8, pp. 10--17, Aug. 2001

[19] Wesley W. Terpstra, Stefan Behnel, Ludger Fiege, Andreas Zeidler Alejandro P. Buchmann, "A PeertoPeer Approach to ContentBased Publish/Subscribe" ,ACM, 2003

[20] M.cilia,L. Fiege, C.Haul and A.P.Buchman, " Mobility Support with REBECA," In the proceedings of the 23rd International Conference on Distributed Computing Systems

AUTHORS PROFILE

Mrs. R. VASANTHI, Research Scholar of Anna University of Technology, Coimbatore . Assistant Professor in Department of Computer Science Engineering, Tagore Institute of Engineering and Technology, Attur , Salem, TamilNadu. She has to her credit 5 technical papers published in various National Conferences. She is an Associate Member of Institution of Engineers (India). Her main research interest includes middleware platform in pervasive computing

Dr. R.S.D.WAHIDABANU, Professor & Head, Department of ECE, Government College of Engineering, Salem, Tamilnadu, India. She has to her credit 100 technical papers published in various International Journals and National Journals. She has authored a book on Object Oriented Programming. She has served the department of Directorate of Technical Education for 25 years and produced numerous Electronics and Communication graduates, many M.E. scholars and few M.Phil. scholars. Supervising a lot of Ph.D. programme and organized not less than 25 conferences. Life Member of Indian Society of Technical Education (33863), Computer Society of India (000811655) as well executive member of Local chapter of Institute of Engineers. Also an active member of Salem Local Chapter (123649-5), Systems Society of India LM 27057 and VDAT Member during 2003-2005 (1049).She is a Member of the Board of Studies in Electronics and Communication Engineering and Electronics and Instrumentation Engineering Branches, Government College of Technology (Autonomous), Coimbatore. She is a Governing council member of two Engineering colleges in Tamilnadu. Has lot of interest in upliftment of Women.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Watermarking Social Networking Relational Data using Non-numeric Attribute

Rajneeshkaur Bedi[1]
Assistant Professor of Computer Engineering
MITCOE, Pune INDIA.
meenubedi@hotmail.com

Dr. Vijay M. Wadhai[2]
Professor and Principal of MITCOE
Pune INDIA.
wadhai.vijay@gmail.com

Rekha S. Sugandhi[3]
Assistant Professor of Computer Engineering
MITCOE, Pune INDIA.
rekha.sugandhi@gmail.com

Atul Mirajkar[4]
UG student of Computer Engineering
MITCOE, Pune INDIA.
atulmirajkar@gmail.com

***Abstract*— On-line social networking has become a very popular nowadays. This paper studies the copyright issue of on-line social networks data in relational database. Techniques and concepts of mining for social network is discussed which gives rise to the need of watermarking its data. Proving ownership rights on such data is a crucial issue in social network which can be to some extent contribute to privacy preserving issue also. Watermark key is generated on vowel and consonant count and accordingly the profile image is scaled. Our algorithm is robust against common database attacks.**

***Index Terms*— Mining, Social Networking, Watermarking, copyright protection**

I. INTRODUCTION

Social networking sites are nowadays gives people a status symbol on how much social human being they are. More the number of sites members more they are social. These sites are usually formed by daily and continuous communication between people on their subject of interest and therefore include different relationships and role. Some use these networking sites to promote their blogs, to post bulletins and updates or to use them as a bridge to a future love interest. These are just a few of the reasons why social networking is getting a lot of attention lately -- it makes life more exciting for many people.

As defined by [10] network sites as web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system. The nature and nomenclature of these connections may vary from site to site.

From the point of data mining, a social network[17,18,19,6] is a heterogeneous and multirelational data set represented by graph. The graph is typically very large, with nodes corresponding to objects and edges corresponding to links representing relationships or interactions between objects. Both nodes and links have attributes. Objects may have class labels. Links can be one-directional and or not required to be binary.

Mining process [1,4,5,6] in social network bring about several new tasks:

- Link-based object classification, type & link prediction, existence, cardinality estimation.
- Object type prediction, reconciliation.
- Group / cluster detection or identification.
- Sub graph detection.
- Metadata mining.

Social network is mine for various things like multimedia data, text, usages, structure etc. Different behaviour pattern is studied by the researchers. Various efficient algorithms are proposed for addressing attacks, sentiment / emotions extractions, crime analysis, privacy preserving and other information from its large database.

Mining of various data on social network is done on public and private data the need of privacy preservation is in demand. Privacy policies given by these sites are well defined from their perspective but due to the lack of awareness to user leads to privacy breach. We can think of having watermarks on the user data on net can atleast limit to misappropriate data exchange or sell.

The issue of privacy / copyright of digital content is taken at priority by owner who provides these data due intellectual property rights. Digital contents are photos, videos, software, audio, text etc. Protection of this asset demands for watermarking it for the copyright and intellectual protection. Steganography is age old method for information hiding and

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

data security, which is further classified (see fig. 1) for protection against detection and removal. It branch out for watermarking and fingerprinting for security.

Watermarking is a process of embedding information in the original content. As we are dealing with digital data this watermarking is also digital watermarking. Digital watermarking[11] must have atleast following three properties:

- It must be robust.
- It cannot be removed or destroyed without destroying the value of the of watermarked document.
- The original and watermarked documents should be perceptually identical.

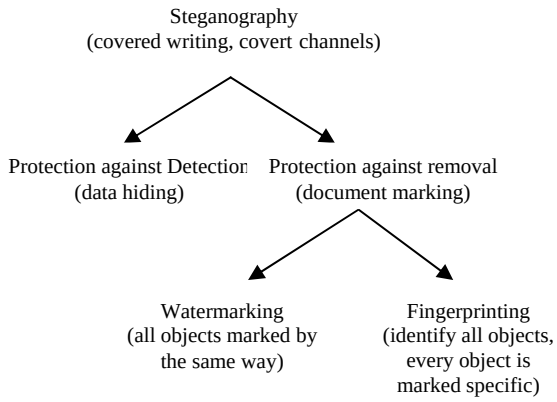


Figure 1

The paper is structured as follows: section 1 is the background and introduction of this paper; with the review of the literature about social networking mining and watermarking is provided in section 2. In section 3, our proposed methodology is given. In section 4, we conclude with our future work scope.

II. Related Work

D. Jensen and J. Neville [4] in 2002 share the potential research areas in data mining in Social Networking. According to them three features of relational data is identified – Concentrated linkage, degree disparity, and relational autocorrelation. Need of useful algorithm and proper data representation is challenging issue. Jon Kleinberg [3] has focused on two themes: the inference of social processes from data, and the problem of maintaining individual privacy in studies of social networks. This gives us an insight of how social networking data can be made available to researcher while protecting the privacy of the individual user participating in such sites. Various type of mining as mentioned by I-Hsien Ting [1] and Aleksandra Korolova, Rajeev Motwani, Shubha U. Nabar, Ying Xu [2], is possible on social networking which results on privacy breach or preserving the privacy difficult.

A robust and blind approach for watermarking relational database is given by Ali Al-Haj and Ashraf Odeh[12] based on binary image watermarks in non numeric multiword attributes of selected database tuples. Another approach by Damien Hanyurwimfura, Yuling Liu and Zhijie Liu[13], to insert mark by horizontally shifting the location of a word within the selected attribute of selected tuple using Levenshtein Distance. CUI Xinchun, QIN Xiaolin, SHENG Gang[14], used an one hash function and user known secret key to select tupe and bits to be marked. Mohamed Shehab, Elisa Bertino and Arif Ghafor [15], used genetic algorithm and pattern search technique based on the application time and processing requirement. Vahab Pournaghshband[16] approach inserts new tuples that are not real and called them "fake" tuples, to the relation as watermarks, which increases the size of database. Watermarking relational database for numeric data was first proposed by Rakesh Agrawal and Jerry Kiernan[7] to flip specific least significant bit 0 to or 1 to 0 based on the value of hash function on selected tuple.

Most of the proposed algorithm lack to address the individual data copyright. They focused on relational database whereas our approach is to watermark each tuple as every value is individuals' data.

III. OUR APPROACH

We have suggested to watermark every tuple in a database on the theory that every individual has right to copyrights its original data. First we generate the secret key based on vowel and consonants in specified attributes, then compute to get a key which stored/hidden in any numeric attribute for future reference. Secondly we change the secretly the image of user profile picture accordingly. Whenever the content ownership is in question watermark detection algorithm can be used.

Creation of a secret key:

{

1: Consider the fields which are highly susceptible of being tampered and calculate the number of consonants and vowel for each field. Also find the ASCII value of the first alphabet of that particular field.

2: Form a 3*3 matrix with columns as consonants, vowels and ASCII value. By using adjoint method calculate the inverse of the matrix.

3: In the next step, multiply the inverse of the matrix with a 1*3 matrix to get a resultant 1*3 matrix. Typecast the elements from floating point numbers to integer values.

4: Calculate the ASCII value of each character of each element of the 1*3 matrix and add these ASCII values to get a secret key which is used to insert a watermark.

5: Append the key in any numeric field.

}

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Insertion of watermark:

{

1: The watermark is inserted into the profile picture of the user, using the above generated secret key. The scale of the image to be displayed could be mapped within the range of 150 to 165 pixels for width and 100 to 150 for height.

2: As per the value of the key the scale of the image is set to achieve the watermark.

}

Detection of watermark:

{

1: Reversal of steps is carried out to get the secret key from the scale of the image.

2: This key is then checked with the key which is appended at the end of the numeric field while creating the secret key. If both these values are same no tampering is done to the data and the data is secured.

}

Complexity of this algorithm $O(n^3)$, based on the algorithm used to find inverse of matrix.

EXPERIMENT RESULT

To test the validity and robustness of this algoritms, we perform experiment on computer running Windows XP with 2.4 GHz CPU and 256 MB RAM. For this work, the student dataset of the college is used. As our approach is attribute based we are demonstrating here is also attribute oriented. Applying our proposed method for one sample data:

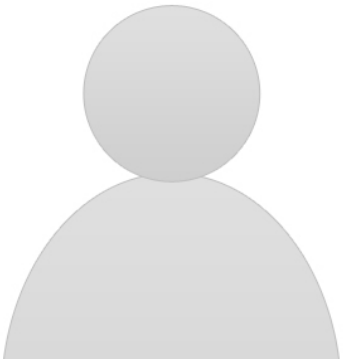
First Name	Last Name	Email ID
Achilles	Enceladus	abcxyz@gmail.com

1. Putting no. of vowels, no. of consonants and ASCII of first character of above attributes in a 3x3 array matrix linedocmat[].
   3 5 99
   4 5 110
   4 10 98
2. Calculate determinant det=390
3. Calculate co-factor of each element of linedocmat[]
4. Transpose it and find its inverse by dividing it by the determinant. Multiply each element by 10 and convert it to integer (For getting a computable whole number).
5. Put value of (consonants-vowels) for each of the above attributes in a 1x3 array, arr[].
6. Multiply arr[] and inverse to get a 1x3 matrix.[-31 23 3]
7. Convert the above 1x3 matrix values to string format and get the ASCII of each character [45, 51,49 50,51 51] (Eg. Ascii of – (minus) is 45, 3 is 51 and so on)
8. Sum of all values in the 1*3 matrix sum=297
9. Append this value of sum to a numeric attribute.

Embedding value of sum in picture scaling:
1) Divide sum by 150 i.e. 297/150
Quotient=1 remainder=147

2) Calculation of new scale
Height=100+quotient*10+remainder%10 = 100+1*10+7=117
Width=150+int (remainder/10) =150+14=164

Original pic :
Scale = 400*300



New pic:
Scale=164*117

, result obtained helps us to address the intentional attacks on attribute value altering. If the attacker alters value of any of the columns, there is very less chance of getting failed in watermarking as the mark and its key value are available at different location. The proposed model is also resilient to tuple addition and deletion. As the image scale is based on it, so easy to suspect the database tampering.

IV. CONCLUSION

In this paper, we tackled the important problem on water marking the relational database of social networking sites. We addressed the problem systematically and developed a practically implementation solution.

As social networking data is very complicated and sensitive so, copyright of personnel data for privacy preserving is challenging and needs many serious efforts in future as when we talk about issue related social networking sites healthcare,

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

medical etc. In future we would like to focus on joint cryptography and watermarking. The complexity can be further improved.

REFERENCES

[1] I-Hsien Ting,"*Web Mining Techniques for On-line Social Networks Analysis"* 978-1-4244-1672-1/08/$25.00 ©2008 IEEE.

[2] Aleksandra Korolova, Rajeev Motwani, Shubha U. Nabar, Ying Xu Link, "Link *Privacy in Social Networks*", CIKM'08, October 26–30, 2008, Napa Valley, California, USA.ACM 978-1-59593-991-3/08/10

[3] Jon Kleinberg, "*Challenges in Mining Social Network Data: Processes, Privacy and Paradoxes"*, KDD'07 August 12-15,2007 ACM.

[4] D. Jensen and J. Neville. "*Data Mining in Social Networks*". In National Academy of Sciences workshop on Dynamic Social Network Modeling and Analysis, 2002

[5] Aris Gkoulalas-Divanis and Vassilios S. Verykios, "*An Overview of Privacy Preserving Data Mining*", ACM Summer 2009/Vol14.No. 4

[6] Jiawei Han and Micheline Kamber, *Data Mining: Concept and Techniques* Second Edition

[7] Rakesh Agrawal, Jerry Kiernan, " *Watermarking Relational Databases*", Proceedings of the 28th VLDB Conference, Hong Kong, China, 2002

[8] Zekeriya Erkin, Thijs Veugen, Tomas Toft, Reginald L. Lagendijk, "*Privacy-Preserving User Clustering In A Social Network*", WIFS 2009, 978-1-4244-5280-4/09, pg no. 96-100

[9] Neri Merhav, *Fellow, IEEE*, "*On Joint Coding for Watermarking and Encryption*", IEEE TRANSACTIONS ON INFORMATION THEORY, VOL. 52, NO. 1, JANUARY 2006

[10] Boyd, d. m., & Ellison, N. B. (2007). *"Social network sites: Definition, history, and scholarship."* Journal of Computer-Mediated Communication, *13*(1), article 11. http://jcmc.indiana.edu/vol13 /issue1/boyd.ellison.html

[11] Muhammad Abdul Qadir, Ishtiaq Ahmad, "*Digital Text Watermarking: Secure Content Delivery And Data Hiding In Digital Documents*", 0-7803-9245-O/05/$20.00,2005, IEEE

[12] Ashraf Odeh and Ali Al-Haj, "*Watermarking Relational Database*", 978-1-4244-2624-9/08 2008 IEEE

[13] Damien Hanyurwimfura, Yuling Liu and Zhijie Liu, "*Text Format Based Relational Database Watermarking for Non Numeric Data*", International Conference on Computer Design and Application, 2010.

[14] CUI Xinchun, QIN Xiaolin, SHENG Gang, "*A weighted Algorithm for Watermarking Relational Database*", Wuhan University Journal of Natural Sciences, Vol.12 No. 1 2007 079-082.

[15] Mohamed Shehab, Elisa Bertino and Arif Ghafor, "*Watermarking Relational Databases Using Optimization-Based Techniques*", IEEE Transactions on Knowledge and Data Engineering, Vol.20, No.1 Jan'08.

[16] Vahab Pournaghshband, "*A New Watermarking Approach for Relational Data*", ACM-SE'08,March 28-29,2008,Auburn, AL, USA. ACM ISBN 978-1-60558-105-7/08/03

[17] Xi Chen and Shuo Shi "*A Literature Review of Privacy Research on Social Network Sites"*, 2009 International Conference on Multimedia Information Networking and Security, *IEEE Computer Society*, DOI 10.1109/MINES.2009.268,2009

[18] Bruce Schneie BT, "*A Taxonomy of Social Networking Data*", IEEE Computer and Reliability Society, July/August 2010, pg.88

[19] Bhavani Thraisingham, "*Data Mining, National Security, Privacy and Civil Liberties*", SIGKDD Explorations. Volume 4, Issue 2 – page 1-5

AUTHORS PROFILE

Rajneeshkaur Bedi has received B. E. degree in Computer Engineering from Amravati University, India in 1997 and M.Tech degree in Computer Engineering from Pune University, India in 2005. She is a registered Ph.D student of Amravati University. She is working as Head and Assistant Professor in Computer Engineering at MITCOE, Pune, India from last 10 years. She has more than 15 years of teaching experience. Her research interest includes Data mining, Data Privacy, Natural language processing, cyber forensic, cryptography and Machine learning. She is a life member of ISTE and CSI.

Dr. Vijay M. Wadhai received his B.E from Nagpur University in 1986. M.E from Gulbarga University in 1995 and Ph.D degree from Amravati University in 2007. He has experience of 25 years which includes both academic (10 years) and research (14.7 years). He has been working as a Principal, MITCOE, Pune (sinve 21st feb 2011) and simultaneously handling the post of Director Research and Development Intelligence Radio Frequency (IRF) Group, Pune (from 2009). He is guiding 16 students for their PhD work and PG projects in both Computer and Electronics and Telecommunication domain. He has published 60 papers in various conference anf Journals (30 in International Journal, 21 in International conference and 9 in national conferences). On his credit two patents are their in the field of mhealth and data mining. His research intrest includes Data Mining, Natural Language processing, Cognitive Radio and Wireless Network, Spectrum Management, Wireless Sensor Network, VANET, Body Area Network, ASIC Design, VLSI. He is a member of ISTE, IETE, IEEE, IES and GISFI (Member Convergence Group), India.

Rekha S. Sugandhi has received B. E. degree in Computer Engineering from Pune University, India in 1998 and M.Tech degree in Computer Engineering from Pune University, India in 2006. She is a registered Ph.D student of Amravati University. She is working as Assistant Professor in Computer Engineering at MITCOE, Pune, India from last 08 years. She has more than 11 years of teaching experience. Her research interest includes Natural Language Processing, Machine learning, Usability Engineering and Human Computer Interface, Data mining. She is a life member of ISTE and CSI

Atul Mirajkar is persuing his undergraduate degree of computer engineering under Pune University at MITCOE. His present research intreset includes databases, data mining, Cryptography and Image Processing.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Internet Adoption in Indonesian Education

Are Female Teachers Able to Use and Anxious of Internet?

Farida[1], Sri Wulan Windu Ratih[2], Betty Yudha Sulistiowati[3], Budi Hermana[4]
[1,2,3] Faculty of Computer Science and Information Technology, [4]Faculty of Economics, Gunadarma University
Jl. Margonda Raya No.100, Depok City, West Java, Indonesia
[1]farida@staff.gunadarma.ac.id, [2]sriwulanwr@staff.gunadarma.ac.id
[3]betty_yudha@staff.gunadarma.ac.id, [4]bhermana@staff.gunadarma.ac.id

***Abstract*— This research aims to determine the patterns of internet usage behavior and perceptions of the internet among female teachers in elementary schools, in terms of Internet Anxiety and Internet Self-Efficacy. The level of adoption is measured by two groups of measurement they are the internet adopter and non-adopters, and also adopters, potential adopters, and non-adopters. The object of research was taken by sampling from 264 female teachers who teach in Jakarta and outside Jakarta. The result shows that Internet adopter groups tend to show higher perceptions of the Internet usefulness, the practical use, technical understanding, and social influence, while groups of potential adopters and non-adopters tend to exhibit a high level of anxiety about the internet. The level of adoption on Internet usage can be predicted by using the Internet anxiety and Internet self-efficacy with prediction rate of 58.8 percent for three-level scale adoption of Internet adopters, potential adopters, and non-adopters, and 71.9 percent for two-scale of the Internet adopter and non-adopters. Teachers who teach in private schools show higher level of internet adoption than those in public schools. Another result from the research is the female teachers working outside Jakarta are more anxious of internet usage than those who work in Jakarta.**

Keywords: Internet Anxiety, Internet Self-Efficacy, Digital Divide, Gender Issues

I. INTRODUCTION

Information and communication technologies could give a major boost to the economic, political and social empowerment of women, and the promotion of gender equality [1]. The formation of gender stereotypes in activities associated with ICTs is a complex process, and of gendered patterns of use is influenced by many factors and well documented in education in the West. It is worrying to see these patterns being produced in societies in which ICTs are a recent introduction [2]. Many developing nations have failed to incorporate a resource in great abundance, their women, to use these new technologies to greatest advantage [3]. 1995 Beijing Declaration stated that ensure women's equal access to economic resources, including land, credit, science and technology, vocational training, information, communication and markets, as a means to further the advancement and empowerment of women and girls, including through the enhancement of their capacities to enjoy the benefits of equal access to these resources, inter alia, by means of international cooperation [4].

The rate of Internet adoption has grown for both genders between the years 1991- 2001, although the rate of women's adoption is lower than that of men. The adoption's rate of the Internet for women in the year 2001 was around 40% while men's percentage of Internet adoption was around 55% [5]. According to [6], The WWW is the fastest- growing segment of the Internet, growing at rate of 3,000 per cent every year. It allows exchange of multimedia data (text, audio, video, graphics and animation) between users connected to the Internet using hypertext links. The Internet Society expects 120 million hosts to be connected to the Internet by the end of the decade, up from 9.5 million in 1996. And the information revolution offers both opportunities and challenges to women.

Indonesia is one country in Asia that has the level of ICT penetration that is still relatively low compared to the average of Asia and the World. However, in 2010 Indonesia has established a significant increase for the indicator Networked Readiness Index (RDI) based on the Global Information Technology Report 2009-2010 published by the World Economic Forum [7]. Reference [8] stated that Indonesia ranks 67th, significantly improving from last year. Asia's third-largest economy delivers a mixed performance, with rankings in the different pillars ranging from a 23rd place in individual readiness to a mediocre 100th position in the infrastructure environment. Indonesia showed a high value on Readiness Index and ranks in 43rd of 133 countries, but for Individual readiness sub index, Indonesia ranked better and ranks in 23rd. The problem is Indonesia still faces obstacles to infrastructure environment that is only rank in 100th. In the Asia-Pacific region, Accessing information from the Web is infrequent, as is advocacy via the Internet. The reasons for not optimizing the ICT tools include technical problems associated with file transmission, connections and disconnections due to poor infrastructure, high usage costs and budgetary constraints, lack of awareness of potential uses and benefits, and inadequate skills to exploit the possibilities [1].

There are still some formidable barriers to overcome in increasing women's use of the Internet and ensuring that they participate fully in the Information Society [9]. Ministry of

This research funded by Ministry of National Education of Indonesia

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Women Empowerment of Indonesia stated that the field of technology, especially ICT, is still very close to the identity of men while women are often just as objects [10]. It is necessary to make women's literacy and information technology to improve the potential of the nation. The number of women in Indonesia almost half of population who are potential if properly empowered. For example, ICT closer to the woman for a great potential not only as objects. Women have been excluded from important aspects of society and governance for many centuries; information society technologies could reinforce that marginalization if women do not master the technology and speak out about the future of the Information Society [9]. According to [11], It cannot be seen that boys and girls have different interests in the Internet technology in practice. But boys talk about their knowledge to a greater extent, and this interplays with their reflections about the Internet's reliability.

Currently, the Education sector in Indonesia has received a major concern of the government budget. Education sector has got at least 20% of government budget. The government has decided to enactment of the certification of teachers and lecturers who accompanied also by granting allowances from the government. Education in Indonesia, including sectors that are relatively advanced in terms of application of ICT, both in the use of ICT in teaching-learning process, as well as individual use by students and teachers. Ministry of National Education reported that in 2007 the number of school principals and teachers of elementary schools in Indonesia at this time amounted to 1,386,676 people. There are more numbers of principals and teachers in public schools than those in private schools that is 1,263,564 people compared to 122,112 people. The number of elementary school teachers, are 1,239,154 people consisting of 747,036 female and 492,118 male teachers. This figure shows that the number of female teachers are bigger than male teachers (the number female teachers is 60,29%). The data also shows that there are 146,813 elementary schools throughout Indonesia.

The ability and willingness of female teachers in elementary schools in using internet become a dilemma. On the one hand the development of internet encourages teacher to know and understand what the internet is, but on the other hand, the negative impact of internet can be a factor affecting the perception and attitude in accepting the existence of the internet. In addition, to control internet also requires a basic knowledge or skills of a technical nature. Success in using the internet is influenced by the understanding and control some media support facilities such as internet connections, personal computers, and other pheriferals. According to [12], while teacher age, gender and school level were not significant, teachers' ratings indicated ICT activities and longer courses contributed significantly to their professional renewal.

An understanding of internet as a medium of information requires a basic knowledge of it. Thus, the level of concern about the internet (internet-anxiety) and the ability of the knowledge and skills in internet usage (internet-self efficacy) were factors be suspected to affect the level of internet adoption by female teachers at the elementary school. This research aims to analyze their behavior toward the internet usage and influence in terms of internet-anxiety and self efficacy based on the level of internet adoption by female teachers in elementary schools in Jakarta and outside Jakarta.

II. THEORETICAL FRAMEWORK

A. Internet and Woman in Education

Common claims that the Internet constitutes a masculine or contrarily a feminine environment are critically discussed, as well as the cyber feminist contention that the Internet enables new identities not limited by gender. It is argued instead that gender and the Internet are multidimensional concepts that are articulated in complex and contradictory ways [13]. According to [14], Various levels of gender disparity exist in the adoption of the Internet. These gender disparities are functions of factors such as male-female cultural differences; differences in specialization, preferences for jobs, and education; complex interactions among the features of the Internet and gender; and external variables such as socio-cultural and economic factors.

The sustained increase in the number of users of computers and Internet connections seems to indicate that the first digital divide can be resolved in the future. The second digital divide, related to the skills necessary to obtain all the benefits of access (digital literacy), affects women more than men [15]. This difference in the ability of countries, regions, sectors and socio-economic groups to access knowledge through ICTs, and to use them for a range of different purposes, has been coined the "digital divide" or "information poverty" [1]. Women and men allocate their time during the day differently, mostly for functional reasons but also partly as a result differences in education level, work status and cultural values But they both spend the same time on media and leisure activities [5].

Reference [16] stated that women and men differ in their perceptions but not use of E-mail. These findings suggest that researchers should include gender in IT diffusion models along with other cultural effects. According to [17], adoption of the Internet is very sensitive to cultural factors, since it is perceived in many traditional societies as a threat to the traditional and well-established modes of doing things. In [18] stated that women tended to reflect on significant structural barriers, such public policies that failed to facilitate the development of the IT sector, gender discrimination by employers, and training which provided them with insufficient technical skills to enable them to effectively perform in the workplace. Men tended to report greater confidence in using the Internet and Women tended to hold less gender stereotyped attitudes about the relationship between computers and the Internet than did men [2].

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Technology such as Information and Communication Technology (ICT) is a potent force in driving economic, social, political and educational reforms. Education reform is occurring throughout the world and one of the tenets of the reform is the introduction and integration of ICT in the education system [19]. The introduction of new information technology in teaching and learning has impacted the traditional classroom activities. The various technologies generate a greater level of interaction between and among teachers and students. They also help to enhance the educational environment while providing enrichment in the learning experience [20]. According to [21], the use of technology has not only created new opportunities within the traditional classroom but has also served to expand learning experiences beyond the popular notion of "classroom". Instruction on the Internet accentuates the 'Student as worker" and the "teacher as coach" paradigms. Teachers' attitudes toward ICT are clearly multi-faceted and tend to become more positive due to ongoing, needs-based training across attitudinal types. Anxiety tends to be reduced rather quickly with meaningful exposure to ICT. On the other hand, enthusiasm/acceptance of ICT and belief in the utility of ICT for professional productivity is slower to evolve [22].

One type of technology that is widely used in the teaching-learning process nowdays is internet or web technology. Profit organizations and traditional institutions of higher education have developed and implemented web-based courses, though they haven't known exactly their effectiveness compared to traditional classroom teaching model. Virtual learning environments have recently become a viable education alternative. Educators who intend to offer training in web-based virtual learning environments should consider a number of alternative courses of action aimed at increasing learner satisfaction with the process [23]. In keeping with a socio-technical perspective of information system, it has been shown that both technology characteristics (easy of finding and easy of understanding) and individual user characteristics (self efficacy and computer anxiety) influence perceived easy of use of web based learning technology [24].

Along with word processing, Internet may be the most valuable medium of many computer technologies available to teachers and students. The kinds of teachers that are most likely (or in the case of math teachers, least likely) to be drawn to the Internet—(1) younger teachers, (2) teachers who are leaders in their profession, and (3) teachers with constructivist pedagogies [25]. Teachers who have been using ICT extensively in their teaching and professional tasks still demand for a wider range of training and support in this area. The eagerness to learn more and acquire further support is high among the teachers [26]. Along with changed student and teacher roles, ICT is contributing to changing the whole structure of schools [27].

On the issue of technology integration in education, there are considerable disparities between developed and developing countries. Developed countries have more resources, knowledge, skills and experience than developing countries [19]. Exploring Digital Divide issues in the schools requires educators to examine the access students have to technology as well as the equity in the educational experiences students have with technology [28]. Teachers who have low ICT skills also have low e-learning skills, which were proven to cause low teacher performance in digital technologies, in which teachers failures in that divergence in the digital world may be the most possible result [29]. Teacher trainers who rejected adoption or discontinued use of the ICT skills often reported that using the skills was too difficult and they were not given adequate guided practice opportunities to master the skills [30].

B. Internet Anxiety and Self-Efficacy

Relation model between information technologies and other factors has become the object of study or research which developed rapidly in 1990s. In [31] stated that in the late 1960s and early 1970s, Fishbein and Ajzen began developing a theory that would help researchers in understanding and predicting the attitudes and behaviors of individuals. Behavioral theory is widely used to study the process of adoption of information technology by end users. Among the theories used are the Theory of Reason Action, Theory of Planned Behavior, Task-Technology Fit Theory, and the Technology Acceptance Model. Technology Acceptance Model (TAM) is the most extensive research model used to examine the adoption of information technology. Reference [32] explain that within the last 18 years TAM is a model which is very popular and widely used in research on information technology adoption process. TAM model was first found by Davis [33]. According to [33], the main purpose of TAM is to provide a basis for tracking the influence of external factors on the beliefs, attitudes, and goals of users. TAM assumes that 2 individual beliefs, namely perceived usefulness and perceived easy of use, are the main effect for computer acceptance behaviors.

Reference [34] have used models based on social cognitive theory developed by Badura to test the effect of computer self-efficacy, outcome expectations, interests or concerns, and anxiety towards computer use. In this theory, self-efficacy is an antecedent to the use of technology. Emotional responses such as attention and anxiety are influenced by self-efficacy. Reference [35] define an Internet-Self-efficacy (ISE) as one's confidence in his abilities to manage and conduct a series of actions to produce a particular achievement.

Reference [36] defines self-efficacy as a consideration a person's ability to use technology in completing certain tasks or jobs, while [37] defines it as one's beliefs about knowledge and skills to evaluate the benefits of a technology. Internet self-efficacy as a significant predictor variable used eight predictor variables to analyze the adoption of e-mail,

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

company's website, and e-sales system. Computer Self-efficacy is an emotional reaction or anxiety that permeated the mind when running activities, for example when using computers [36]. Reference [38] stated that although Internet usage levels may not have any impact on computer self-efficacy, higher usage of the Internet does seem to decrease the levels of computer anxiety among the undergraduates.

Individual perceptions of other factors that are predicted to give influence toward the behavior or the level of internet adoption are a concern from internet's users itself. These concerns could be due to anxiety of the negative impact such as confidentiality or security of the internet usage or the impact of negative content such as viruses, pornography, or other negative impacts. Wexler in 2001 stated that Internet anxiety is the fear or anxiety of one's ability to succeed with a new system, for example in using the internet [24]. Emotional reactions or anxiety that permeated the mind arises when running the activity, for example when using computers [36]. Reference [39] stated that the combined effect Internet enjoyment, anxiety, and efficacy contributed significantly to Internet usefulness; and the combined effect of Internet usefulness, enjoyment, and efficacy contributed significantly to Internet anxiety. According to [40], Anxiety has been argued to impact computer-based learning by affecting levels of self-efficacy anchored in social learning and outcome expectation theories. Self-efficacy is determined by levels of anxiety such that reduced anxiety and increased experience improves performance indirectly by increasing levels of self-efficacy.

Some researches on internet self-efficacy and internet anxiety in the education sector have been developed in some countries, including in Taiwan by [41], [42], and [43]; in Turkey by [44]; in United States by [45]; in Malaysia by [46] and [38]; in UK and Australia by [47]; in Canada by [40]; and in Singapore by [48]. Some quotations of the research results can be seen in the following paragraphs.

The male students also revealed better Internet self-efficacy than their female counterparts. Students' attitudes toward the Internet could be viewed as one of the important indicators for predicting their Internet self-efficacy [41]. There is a significant relationship between pre-service teachers' internet self-efficacy and their self-efficacy [44]. Respondents with 'low' computer anxiety improved their self-efficacy significantly more than respondents with 'high' computer anxiety [45]. The SEM analysis showed that students with higher general Internet self-efficacy clearly showed more preferences toward Internet learning environments where they can use with ease, explore real-life problems, display multiple sources of information, conduct open-ended inquiry learning activities, and elaborate the nature of knowledge [42]. Infusing constructivism into a discrete IT course can reduce the anxiety level among participants who perceived themselves as IT incompetent [46]. Student teachers' self-efficacy is a significant influence on whether they use technology in a traditionalist or constructivist way [48].

III. METHODOLOGY

Respondents of this research are teachers who teach at elementary schools in Jakarta and Depok. The consideration to choose Jakarta area is because Jakarta is a barometer for the development and application of internet technologies, especially in education sector. Depok is chosen as the comparison of patterns and behavior of internet usage by teachers in Jakarta. The aim of this research is to investigate the possibility of a digital divide between female teachers in Jakarta and outside Jakarta, though the distance between the two regions is still relatively close together. Methods used to determine the respondent is judgment sampling. Number of questionnaires distributed are 500, but the number of valid and complete data for analysis are as many as 264 respondents.

The design of the research uses cross-sectional method. It was measured in the time period mid-2010. Research instrument used is a Likert Summated Rating (LSR) in the scale of 7 for variable internet self-efficacy and internet efficacy. The questions for internet self efficacy refers to [35], while internet anxiety refers to [36]. Those two variables are predictors for the level of adoption which has the categorical of internet-adopter and non-adopters. Internet-adopter respondent is respondents who already use the internet at the time of data collection while the non-adopter respondent is respondents who did not use the internet at data collection. In addition, this research also uses the internet potential adopter categories, namely respondents who did not use the internet at data collection, but intend to use them in a period of six months.

The research instrument is in the form of questionnaires distributed to teachers in the target areas. The research instrument consists of four parts: (1) individual profiles of the respondents, (2) profile usage of information and communication technology either at schools or at home by the respondents themselves (3) the perception of respondents towards the internet that contain variables that are adopted from the Unified Theory of Acceptance and Use of Technology by Venkantesh, and (4) behavior or the intensity of Internet usage as well as inhibiting factors and the factors driving its use. Reliability testing of research instrument uses Cronbach Alpha including the measurement of point-biserial correlation. Measurement validity uses factor analysis with Principal Component Analysis method which is equipped with a test of Kaiser-Meyer-Olkin (KMO) and Bartlett. The main research model will be analyzed by using Discriminant analysis that provides statistical procedure to identify the contribution of each independent variable on a linear function that shows the difference between the two groups of respondents namely the internet adopters and non-adopters.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Tests of significance use Chi-square model and the Wilks Lambda.

IV. RESULTS AND DISCUSSION

A. Internet Usage Behavior

Most teachers look familiar or accustomed in using information and communication technology facilities such as computers, internet, and mobile phones; even all the teachers have been using a mobile phone. The number of teachers who have personal computers at home are 25 people or 71.4 percent, and who are accustomed to using the internet and have e-mail are 20 people or 57.1 percent and 19 people or 54.3 percent. The number of respondents who had attended computer training are 19 people or 54.3 percent, while those have joined particular training in internet are 7 people or 20 percent.

The number of respondents who considered "adopters" to a personal computer and the internet is greater than 50 percent of 76.89 percent and 67.68 percent, while those who use it for social network and personal websites or blogs are only 51.53 percent and 32.82 percent. An interesting finding is that respondents who do not have a personal computer and do not use it for social networking, they are categorized as potential adopters for they are going to use that information technology services in the next six months. The result is consistent with [5]. There are more women and men using the mobile phone than any other ICTs devices. One of the reasons is that it is easy to operate and supplies an immediate need for communication with no limit in terms of time and space. Their study shows that the ownership of mobile phones among the genders is higher compared to computer and Internet ownership.

Experience in using e-mails ranges from one to 15 years with an average of 3.86 years. Internet per month subscription fee varies with the average of IDR 107,333 per month. Most respondents who already use the internet use the internet connection from home, internet cafe, or school. The numbers of respondents who use the internet connection at school and at home are 75 people. According to [6], women are also more likely than men to use the Internet exclusively from work or academic locations, while men are more likely to use it from multiple locations, including after-hours use from home. More cross tab results to access the internet services can be seen in the table below.

TABLE 1. CROSS-TABULATION OF INTERNET ACCESS

Access at School			Access at Internet Cafes		Total
			Yes	No	
Yes	Access at home	Yes	39	36	75
		No	28	6	34
	Total		67	42	109
No	Access at home	Yes	10	31	41
		No	15	30	45
	Total		25	61	86

Most of respondents who use internet are quite intensive in using internet services. The numbers of respondents who access the Internet every day or almost every day are 39 people or 20.12 percent of the respondents who use internet. The difference in frequency of Internet usage between men and women is relatively high in Indonesia. This condition may be different from those in developed countries which according to some research results showed no gender differences. According to [49], the amount of time that the female students spent accessing the Internet were the same as that of their male counterparts. There were no gender differences detected between them. Features of internet services used by respondents can be seen in figure below.

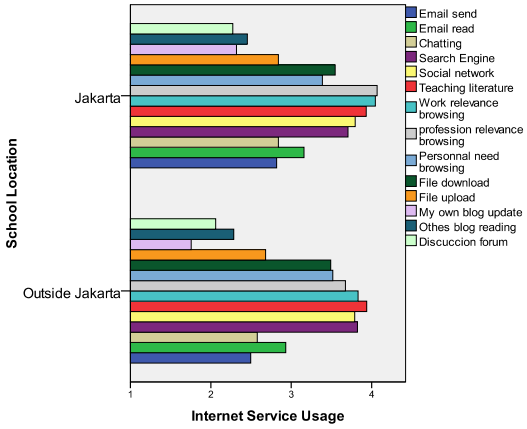


Figure 1. Internet service features

Three features of the internet services that are frequently used by respondents are using search engines to look for teaching materials, visiting sites associated with the profession or employment status, and use of search engines. The search engine is more widely used by teachers who worked outside Jakarta. According to [50], there were significant differences between genders in frequencies of Internet search engine use. On closer observation, female trainee teachers were found to use Internet search engines more compared to their male counterparts for all the three search engines. Three features of the Internet service that is rarely used are reading blogs or other personal websites, followed by the online discussion forums and personal blogging activities. The use of other Internet services which are still quite high is the social network. Social network is an interesting phenomenon in Indonesia where social network user in Indonesia has grown rapidly compared to other countries. In Public Malaysian University, Both genders preferred to use the Internet mainly for accessing information rather than for socializing or leisure purposes [49]. According to [51], women are going online in ever-increasing numbers and finding much to entertain, educate and enlighten them. They are using the internet for many of the same reasons as their male age-mates and for different pursuits as well. Most women love e-mail and the opportunities for interactive chats and discussions. Meanwhile, according to [52], women tend to use the Internet for communication purposes, getting information about health and

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

for education purposes more than men do. Woman tend to use it for entertainment purposes, reading news, downloading movies, music, software, and for e-banking less than men do.

Preview attitude and intensity of internet usage among female teachers show that the internet has become a necessity for most respondents, although the use of internet service is still variable. Behavior diversity and intensity of internet usage are related to perception or understanding of the internet which may vary among individuals. But in general the respondents still face many obstacles or barriers in the utilization of internet. Factors driving and inhibiting factors in the utilization of the internet based on the respondent's point of view can be seen in the table below. According to [6], the cost of equipment, lack of training and the hazards and irritation that some women have encountered on line, as well as the limitations women face in allocating time to networking activities, are obstacles yet to be overcome in many parts of the world. Reference [15] stated that in order to understand the problem of the digital divide, the key lies in accepting that the most difficult barrier to overcome is not that of access (infrastructures, diffusion of appliances), but that of use. From this perspective, the crucial factor is the ability of each individual to use innovations in function of their specific needs and interests.

TABLE 2. OBSTACLES AND DRIVERS OF INTERNET USAGE

Obstacles	Drivers
Busy or lack of time	Need of information
Low skills in using technology	Need of knowledge
high cost	Assist in making the task
Too tired	Communicate
Different brands of computers	Look for reference
Slow in connections	Check email
The lack of knowledge	Know situation or latest information
Limited facilities	Develop insight
Negative impact of internet usage	Develop learning strategies
Virus problem	Meet old friends
Low in willingness to learn	Help students to learn

Most schools already equipped with computer facilities and internet connections or in term of percentage respectively 91.25 percent and 90.91 percent. This indicates that the use of computer and the internet is already a standard feature in elementary schools. Elementary schools which already have a website are only 72.24 percent. With computer facilities and internet connection that can be considered high, it turns out the number of elementary schools which provide internet trainings to their students are still relatively small, at only 48.86 percent that specifically hold internet training to their students. The percentage of teachers who encourage students to use more internet are relatively high namely 77 percent.

B. Internet Anxiety and Internet Self-Efficacy as a Predictors

Basic skill possessed by the respondents is one of the factors that determine the process of Internet adoption. Respondents that classified as internet adopters show higher basic technical ability than the non-adopter group. Teachers who have adequate knowledge and technical skills use the Internet intensively. Increased confidence in using technology and more positive attitudes toward technology can also be promoted by increasing the exposure of the teachers to technology. This can be accomplished through training and professional development activities, and allotted time [53]. Teachers who teach in public schools have a perception of higher technical skills than the teachers who teach at private schools. The difference is smaller than the differences based on the rate of adoption and training experience, as shown in figures below.

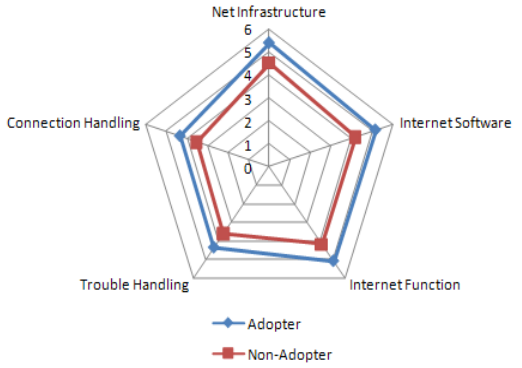


Figure 2. Internet Self-Efficacy and Adoption Level

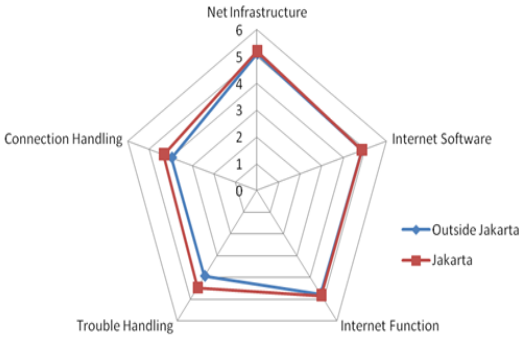


Figure 3. Internet Self-Efficacy and School Location

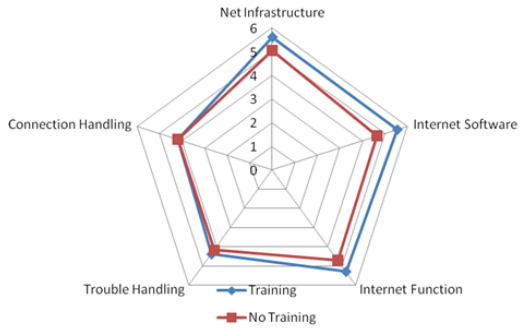


Figure 4. Internet Self-Efficacy and Training Experience

In general, all respondents considered that the Internet is a technology that relatively raises their anxious or fear when used. Perception of internet anxiety is higher among teachers

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

who were classified as Internet non-adopter. This factor is considered to be a barrier factor to Internet use among teachers. Technology education teachers are experiencing minor barriers to technology integration and some technology anxiety as they strived to integrate technology in their instruction. As perceived barriers and technology anxiety increase, technology adoption in instruction by technology education teachers decreases [54]. Teachers who have not received professional certification show a higher level of Internet anxiety than those who have obtained certification. Level of anxiety is also different when viewed from the location of school, internet training experience, and school status as presented in the following figures.

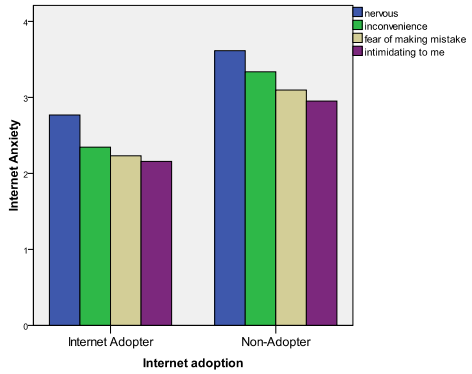


Figure 5. Internet Anxiety and Adoption Level

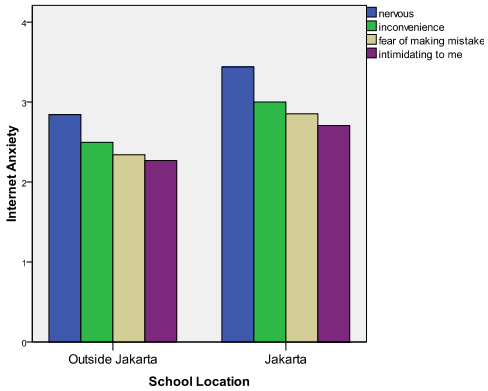


Figure 6. Internet Anxiety and School Location

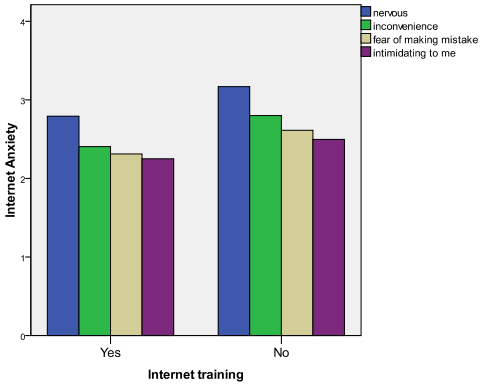


Figure 7. Internet Anxiety and Training Experience

The next analysis is to predict the use of the internet by female teachers using discriminant analysis. The first prediction uses three levels of adoption, namely the Internet adopters, potential adopters, and non-adopters. Potential adopters are respondents who do not currently use the Internet, but have plans to use Internet in the coming six months. The prediction results of the level of Internet adoption by using Internet Anxiety and Internet Self-Efficacy as a predictors can be seen in the table below.

TABLE 3. CLASSIFICATION OF THREE-ADOPTION LEVEL

	Adoption Level	Predicted Group Membership			Total
		Adopter	Potential	Non	
Count	Adopter	129	20	28	177
	Potential	15	10	25	50
	Non	11	8	14	33
%	Adopter	72.9	11.3	15.8	100.0
	Potential	30.0	20.0	50.0	100.0
	Non	33.3	24.2	42.4	100.0

a. 58,8% of original grouped cases correctly classified

The results show that the decision to use or not to use the Internet can be predicted by the Internet Anxiety and Internet Self-efficacy with the level of prediction of 58.8 percent. As long as they are still worried about the internet and feel does not have sufficient technical skills so teachers will not use the internet. Despite the relatively low level of prediction, these conditions indicate that the teacher assumes that the Internet could cause a higher negative impact than positive impact, particularly for teachers who do not currently use the Internet. The negative impact is one of the barriers in using the Internet. According to [55], Internet anxiety was affected both by the users' personality and by beliefs that can be influenced by providing adequate resources to support the technology, encourage trust in technology, and working to assure users that leaders and peers are supportive of their using the technology. Actually Internet developers have considered the ease of use of Internet application from the perspective of user. Thus the end user does not require high skills or knowledge, if only as an ordinary user. Perceptions can be changed by the Internet training to teachers. And cross-classification results show that teachers who had received training in the Internet have a lower level of worry. The training may also increase basic skills in using the Internet so that the teachers who do not currently use the Internet will use the Internet in the future.

However, if the Internet adoption status measured by two levels of adopters and non-adopters, the prediction rate becomes higher at a 71.9 percent as presented in the table below.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

TABLE 4. CLASSIFICATION OF TWO-ADOPTION LEVEL

	Adoption Level	Predicted Group Membership		Total
		Adopter	Non	
Count	Adopter	130	47	177
	Non-Adopter	26	57	83
%	Adopter	73.4	26.6	100.0
	Non-Adopter	31.3	68.7	100.0

a. 58,8% of original grouped cases correctly classified

The results of ANOVA analysis show that only the Internet Anxiety showing significant differences between Jakarta and outside Jakarta. While the Internet self-efficacy shows no significant difference. Teachers who teach outside Jakarta tend to be more anxious than the teachers who teach in Jakarta. Different levels of anxiety are due to socialization or cultural level of Internet usage in outside Jakarta which is relatively lower compared to Jakarta. Another factor is the quality of telecommunications infrastructure and policy support in using the Internet for teaching-learning process. These results are consistent with [1] which states that the ability of women to use information and knowledge is dependent on many factors, among which are literacy and education, geographic location (North or South, rural or urban), and social class. Thus, as the information revolution develops and accelerates migration to the Internet, those without access will suffer greater exclusion.

Percentage of female teachers who use the Internet in the Private School is higher than the Public Schools. The result of chi-square test shows significant differences. These findings may be caused by several factors such as adequate computer facilities at private schools; the higher commitment of internet usage in private schools; or other factors which still require further proof. From the aspect of gender equality, female teacher as stated by the Ministry of Women Empowerment of Indonesia is still relatively marginalized in the field of technology and education than men. According to [9], women have been excluded from important aspects of society and governance for many centuries; information society technologies could reinforce that marginalization if women do not master the technology and speak out about the future of the Information Society. Regarding the impact of equality in education, Reference [39] stated that statistically significant differences in Internet usefulness and anxiety were found among different education levels, male and female employees, and age groups.

Level of anxiety in internet usage by female teachers is also associated significantly with school status. The teachers who teach in public schools is more anxious than those who teach at private schools. Contributing factor is closely related to socialization or training use of the Internet. Perception of anxiety about the internet can be reduced by training programs or technical explanation of the Internet, particularly regarding the understanding of positive and negative impacts to the Internet users or potential users. The government through the education departments should intensify the internet training or courses and encourage internet utilization to support teaching and learning process in class. Users' perceptions of having adequate resources to enable the use of the technology reduced Internet anxiety. Organizations should therefore provide adequate resources, such as training [55]. It is believed that gender would not be a factor influencing undergraduates' attitudes toward computers, computer self-efficacy, and attitudes toward the Internet in the near future, as computers become a prevalent tool in our daily lives, regardless of whether one likes to use it or not [38]. According to [47], there was a significant and negative relationship between Internet anxiety and Internet use. Those who were more anxious about using the Internet used the Internet less, although the magnitude of effect was small. And reference [40] stated that the findings demonstrate the importance of self-efficacy as a mediator between computer anxiety and perceived ease of use of a learning management system.

V. CONCLUSION

Most female teachers in Jakarta and its surroundings are used to using Information and Communication Technology such as personal computers, mobile phones, and internet. Mobile phone is the most commonly used by them. Type of Internet utilization most widely used is information searching related to instructional materials, browsing with search engines, and social networking. Type of Internet service that is at least used is the personal blog or website as well as online discussion forums. Percentage of Internet users is smaller than the user of personal computer and cell phone. There are differences regarding Internet Self-Efficacy and Internet Anxiety among female teachers which depend on the characteristics of respondents and the level or status of adoption of Internet usage. Internet adopters tend to indicate higher Internet self-efficacy while potential adopter and non-adopters tend to show a high level of worry or anxiety. Internet usage rate of adoption can be predicted by using the Internet anxiety and Internet self-efficacy with prediction rate of 58.8 percent for three scales of adoption (adopters, potential adopters, and non-adopter), and 71.9 percent for two scales (adopter and non-adopter).

Teachers who teach in private schools shows higher level of Internet adoption than those who teach in public school. Teachers who work outside Jakarta are more anxious than those who work in Jakarta. Differences in levels of internet anxiety also related to the status of the schools where teachers who work in private schools tend to be more anxious. Female teachers in public schools have higher technical skills than private schools, but the skill difference is smaller than the differences based on training experience and status of internet adoption. Related to the differences of Internet anxiety between location and status of schools, education council or other relevant government agencies need to socialize Internet utilization among teachers who work outside Jakarta and a public school. The impact of training to perceptions changes need to be explored and tested further, including its interaction

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

with the demographic or psychological factors. The recommendation is also related to the finding that the level of internet anxiety is also correlated with Internet-self-efficacy, which indicates that female teachers who are anxious of the Internet also have lower basic technical skill compared to teachers who have been classified as Internet-adopters.

REFERENCES

[1] Primo, Natasha, "Gender Issues in the Information Society", UNESCO Publications for the World Summit on the Information Society. Published in 2003 by the United Nations Educational, Scientific and Cultural Organization (UNESCO), 7, place de Fontenoy F-75352 Paris 07 SP.

[2] Li, Nai and Gill Kirkup, "Gender and cultural differences in Internet use: A study of China and the UK", Computers & Education 48, 2007, p. 301–317.

[3] Leahy, K.B and Ira Yermish, "Information and Communication Technology: Gender Issues in Developing Nations", Informing Science Journal, Special Series on Community Informatics, Volume 6, 2003.

[4] Beijing Declaration, "Fourth World Conference on Women, Beijing 1995", Beijing, China, September 1995.

[5] Brynin, M., Y. Raban, and T. Soffer, "Chapter 5: The New ICTs: Age, Gender and the Family", e-Living: Life in a Digital Europe (IST-2000-25409), 2004.

[6] United Nations, "Women2000 - Women and the Information Revolution", Published to Promote the Goals of the Beijing Declaration and the Platform for Action October 1996. United Nations, Division for the Advancement of Women, Department of Economic and Social Affairs.

[7] World Economic Forum, "Global Information Technology Report 2009–2010:ICT for Sustainability", 2010.

[8] Dutta, S., Mia. I., Geiger, T., and Herrera, E.T, "How Networked Is the World? Insights from the Networked Readiness Index 2009–2010", Global Information Technology Report 2009–2010: ICT for Sustainability. Dutta, S and Mia (Editor). Word Economic Forum.

[9] Goulding, A. and R. Spacey, "Women and the Information Society: barriers and participation", 68th IFLA Council and General Conference, August 18-24, 2002.

[10] Ministry of Women Empowerment Republic of Indonesia, "ICT Approach to increasing ability and empowering woman", 2005.

[11] Enochsson, Annbritt, "A gender perspective on Internet use: consequences for information seeking", The Interactive Institute, Stockholm, Information Research, 10(4) paper 237, 2005, [Available at http://InformationR.net/ir/10-4/paper237.html].

[12] Yates, S.M., "Teachers' perceptions of their professional learning Activities", International Education Journal, 2007, 8(2), 213-221.

[13] Van Zoonen, L., "Gendering the Internet: Claims, Controversies and Cultures", European Journal of Communication Copyright © 2002 SAGE Publications (London, Thousand Oaks, CA and New Delhi), Vol 17(1): 5–23. [0267–3231(200203)17:1;5–23;021605].

[14] Dholakia, R.R., N. Dholakia, and N.Kshetri, "Gender and Internet Usage", University of Rhode Island, 2003.

[15] Castaño, C., "The Second Digital Divide and Young Women", Cecilia Castaño (dir.), La segunda brecha digital, Madrid, Cátedra, 2008.

[16] Gefen, D. and Straub, D. "Gender Difference in the Perception and Use of E-Mail: An Extension to the Technology Acceptance Model," MIS Quarterly (21:4, December), 1997, pp. 389-400.

[17] Nath, R. and Murthy, N. R. V., "A Study of the Relationship Between Internet Diffusion and Culture", Journal of International Technology and Information Management, 2004 Volume 13, Number 2.

[18] Payton, F.C., Kvasny, L., Mbarika, V.W.A., and Amadi, "Gendered Perspectives on the Digital Divide, IT Education and Workforce Participation in Kenya", Proceedings of the 9th International Conference on Social Implications of Computers in Developing Countries, São Paulo, Brazil, May 2007.

[19] Jhurree, Vikashkumar, "Technology integration in education in developing countries: Guidelines to policy makers", International Education Journal, 2005, 6(4), 467-483.

[20] Duhaney, Devon C., "Technology and The Educational Process: Transforming Classroom Activities", International Journal of Instructional Media Vol. 27(1), 2000.

[21] Wegner, S.B., K.C. Holloway, and E.M. Garton, "The Effects of Internet-Based Instruction on Student Learning", JALN Volume 3, Issue 2 - November 1999.

[22] Knezek, G. and Rhonda Christensen, "Impact of New Information Technologies on Teachers and Students", Education and Information Technologies 7:4, 369–376, 2002.

[23] Piccoli, G., R. Ahmad, and B. Ives, "Web-Based Virtual Learning Environments: A Research Framework and A Preliminary Assessment of Effectiveness in Basic IT Skills Training", MIS Quarterly Vol. 25 No. 4, pp. 401-426, December 2001.

[24] Brown, Irwin T.J. 2002. "Individual and Technological Factors Affecting Perceived Ease of Use of Web-based Learning Technologies in Developing Country". The Electronic Journal on Information Systems in Developing Countries. 9, 5, pp. 1-15.

[25] Becker, Henry Jay, "Internet Use by Teachers: Conditions of Professional Use and Teacher-Directed Student Use", Teaching, Learning, and Computing: 1998 National Survey Report #1. Center for Research on Information Technology and Organizations, The University of California, Irvine and The University of Minnesota, 1999.

[26] Bee Theng, Lau and Chia Hua, Sim, "Exploring the extent of ICT adoption among secondary school teachers in Malaysia", International Journal of Computing and ICT Research, Vol. 2, No. 2, pp.19-36.

[27] Anderson, J., "IT, e-learning and teacher development", International Education Journal, ERC2004 Special Issue, 2005, 5(5), 1-14.

[28] Swain, C. and Pearson, T., "Bridging the Digital Divide: A Building Block for Teachers", Learning & Leading with Technology, Volume 28 Number 8, May 2001.

[29] Uzunboylu, H., & Tuncay, N., "Divergence of Digital World of Teachers", Educational Technology & Society, 2010, 13 (1), 186–194.

[30] Richardson, J.W., "Providing ICT Skills to Teacher Trainers in Cambodia: Summary of Project Outputs and Achievements", Journal of Education for International Development 4:2, December 2009.

[31] King, Ruth C. and M.L. Gribbins, "Internet Technology Adoption as an Organizational Event: An Exploratory Study across Industries", Proceedings of the 35th Hawaii International Conference on System Sciences, 2002.

[32] Lee, Younghwa, K.A. Kozar, and K. R.T. Larsen, "The Technology Acceptance Model: Past, Present, and Future", Communication of The Association for Information System, 12, 50, p.752-780, 2003.

[33] Davis, Fred D.,"Perceived Usefulness, Perceived Ease of Use, And User Acceptance of Information Technology". MIS Quarterly. 13. 3. p. 319, 1989.

[34] Compeau, Deborah , C.A. Higgins and S. Huff, "Social Cognitive Theory and Individual Reactions to Computing Technology: A Longitudinal Study". MIS Quarterly. Jun 1999. 23. 2. ABI/INFORM Global. p. 145.

[35] Eastin and R. LaRose, "Internet Self-Efficacy and the Psychology of the Digital Divide". Journal of Computer-Mediated Communication: Sep. 6. 1, 2000.

[36] Venkatesh, Viswanath, M. G. Morris, G. B. Davis, and F. D. Davis, "User Acceptance of Information Technology: Toward a Unified View". MIS Quarterly. Vol. 27. No. 3. pp. 425-478, 2003.

[37] Lee, Jungwoo, "Discriminant Analysis of Technology Adoption Behavior: A Case Oof Internet Technology in Small Business". The Journal of Computer Information Systems. 44. 4. p. 57, 2004.

[38] Sam, H.K., A. E. A. Othman and Z. S. Nordin, "Computer Self-Efficacy, Computer Anxiety, and Attitudes toward the Internet: A Study among Undergraduates in Unimas", Educational Technology & Society, 8 (4), 205-219, 2005.

[39] Zhang, Y., "Age, gender, and Internet attitudes among employees in the business world", Computers in Human Behavior 21, 2005.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

[40] Saadé, R.G. and Dennis Kira, "Computer Anxiety in E-Learning: The Effect of Computer Self-Efficacy", Journal of Information Technology Education Volume 8, 2009.

[41] Wu, Y.T. and Tsai, C.C., "University Students' Internet Attitudes and Internet Self-Efficacy: AStudy at Three Universities in Taiwan", Cyberpsychology & Behavior, Volume 9, Number 4, 2006.

[42] Liang, J.C. and Tsai, C.C., "Internet self-efficacy and preferences toward constructivist Internet-based learning environments: A study of pre-school teachers in Taiwan", Educational Technology & Society, 11 (1), 226-237, 2008.

[43] Tsai, P.S. and Tsai, C.C., "Elementary school students' attitudes and self-efficacy of using PDAs in a ubiquitous learning context", Australasian Journal of Educational Technology, 26(3), 297-308, 2010.

[44] Gürol, A. and Akti, S., "The relationship between pre-service teachers' self efficacy and their internet self-efficacy", Procedia Social and Behavioral Sciences 2, 2010.

[45] Torkzadeh, G., Chang, J.C.J and Demirhan, D., "A contingency model of computer and Internet self-efficacy", Information & Management 43, 2006.

[46] Luan, W.S., Bakar, K.A. and Hong, T.S., "Differences in Anxiety Between IT Competent And Incompetent Malaysian Pre-Service Teachers: Can a Discrete IT Course Taught in a Constructivist Learning Environment Solve This Problem?", The Turkish Online Journal of Educational Technology–TOJET, October 2003. ISSN: 1303-6521 volume 2 Issue 4 Article 4.

[47] Joiner, R., M. Brosnan, J. Duffield, J. Gavin, and P. Maras, "The relationship between Internet identification, Internet anxiety and Internet use", Computers in Human Behavior 23, 2007, 1408–1420.

[48] Teo, Timothy, "Examining The Relationship between Student Teachers' Self-efficacy Beliefs and Their Intended Uses of Technology for Teaching: A Structural Equation Modelling Approach", The Turkish Online Journal of Educational Technology–TOJET October 2009 ISSN: 1303-6521 volume 8 Issue 4 Article 1.

[49] Luan, W.S., Ng. S. Fung and H. Atan, "Gender Differences in the Usage and Attitudes toward the Internet among Student Teachers in a Public Malaysian University", American Journal of Applied Sciences 5 (6): 689-697, 2008.

[50] Chai, L.T., Y. K. Hong, and C. C. Ching, "Exploring Malaysian Trainee Teachers' Adoption of The Internet as Information Tool", International Journal of Instruction. July 2010, Vol.3, No.2.

[51] Leiblum, S.R., "Review**:** Women, sex and the internet", Sexual and Relationship Therapy, Vol. 16, No. 4, 2001. British Association for Sexual and Relationship Therapy, 2001.

[52] Olaya, D., "ICTs and gender: statistical evidence", ICT and gender session. "Gender and ICT" World Summit on the Information Society Forum 10 May 2009, Geneva. http://www.itu.int/ITU-D/ict/papers/2010/PresentationGenderWSIS.pdf

[53] Buckenmeyer, J.A., "No Computer Left Behind: Getting Teachers on Board with Technology", National Educational Computing Conference (NECC), Philadelphia, Pennsylvania, June 29, 2005.

[54] Kotrlik, J.W. and Donna H. Redmann, "Technology Adoption for Use in Instruction by Secondary Technology Education Teachers", Journal of Technology Education Vol. 21 No. 1, Fall 2009.

[55] Thatcher, J.B., M.L. Loughry, J. Lim, and D. H. McKnight, "Internet anxiety: An empirical study of the effects of personality, beliefs, and social support", Information & Management 44, 2007, 353–363.

AUTHORS PROFILE

Farida, SKom, MMSI is a lecturer who worked at Department of Information System, Faculty of Computer Science and Information Technology, Gunadarma University. Her research is concentrated on System Performance Analysis, ICT Adoption Model and E-banking.

Sri Wulan Windu Ratih, Ir., MMSI is lecturer at Department of Informatic Engineering, Faculty of Industrial Engineering, Gunadarma University. Her research interest is human-computer interaction

Betty Yudha Sulistiowati, SKom, MMSI have worked at Study Program of Information Management, Gunadarma University. Her research area are Management Information System and IS Project Management

Dr. Budi Hermana is a lecturer at Faculty of Economics, Gunadarma University. His research interest lie in area of Small Business Management, Financial Institution, and ICT Adoption Model, and New Economics.

Radiation Pattern Synthesis of Linear Antenna Array Using Genetic Algorithm for Reducing Sidelobe Level

T.S.JEYALI LASEETHA[1]
1. Professor, Department of Electronics and Communication Engineering
HolyCross Engineering College, Anna University of Technology, Tirunelveli,
Tamil Nadu, INDIA
Email id: laseetha@gmail.com

Dr. (Mrs.) R.SUKANESH[2]
2. Professor, Department of Electronics and Communication Engineering
Thiagarajar College of Engineering, Madurai
Tamil Nadu, INDIA
Email id: sukanesh@tce.edu

***Abstract*—The Genetic algorithm optimization method is used in this paper for the synthesis of antenna array radiation pattern in adaptive beamforming. The synthesis problem discussed is to find the weights of the antenna array elements that are optimum to provide the radiation pattern with maximum reduction in the sidelobe level. This technique proved its effectiveness in improving the performance of the antenna array**

***Keywords*-Adaptive Beamforming, Sidelobe level, Genetic Algorithm, Linear antenna array, Pattern synthesis, convergence, Array factor.**

I. INTRODUCTION

Adaptive beamforming is a signal processing technique in which the electronically steerable antenna arrays are used to obtain maximum directivity towards signal of interest (SOI) and null formation towards signal of not interest (SNOI) i.e instead of a single antenna the antenna array can provide improved performance virtually in wireless communication. The characteristics of the antenna array can be controlled by the geometry of the element and array excitation. But sidelobe reduction in the radiation pattern [22] should be performed to avoid degradation of total power efficiency and the interference suppression [1],[9] must be done to improve the Signal to noise plus interference ratio (SINR). Sidelobe reduction and interference suppression can be obtained using the following techniques: 1) amplitude only control 2) phase only control 3) position only control and 4) complex weights (both amplitude and phase control). In this, complex weights technique is the most efficient technique because it has greater degrees of freedom for the solution space. On the other hand it is the most expensive to implement in practice.

Pattern synthesis is the process of choosing the antenna parameters to obtain desired radiation characteristics, such as the specific position of the nulls, the desired sidelobe level and beam width of antenna pattern. In literature there are many works concerned with the synthesis of antenna array. It has a wide range of study from analytical methods to numerical methods and to optimization methods. Analytical studies by Stone who proposed binominal distribution, Dolph the Dolph-Chebyshev amplitude distribution , Taylor, Elliot, Villeneuve, Hansen, Woodyard and Bayliss laid strong foundation on antenna array synthesis[16]-[21]. Iterative Numerical methods became popular in 1970s to shape the mainbeam. Today a lot of research on antenna array [1] – [12] is being carried out using various optimization techniques to solve electromagnetic problems due to their robustness and easy adaptivity. One among them is Genetic algorithm [12] .

In this paper, it is assumed that the array is uniform, where all the antenna elements are identical and equally spaced. The design criterion here considered is to minimize the sidelobe level [7] with narrow main beamwidth. Hence the synthesis problem is, finding the weights that are optimum to provide the radiation pattern with maximum reduction in the sidelobe level.

II. GENETIC ALGORITHM

Genetic Algorithms are a family of computational models inspired by evolution [12],[23],[24]. Genetic algorithm (GA) is a procedure used to find approximate solutions to search problems through application of the principles of evolutionary biology. Genetic algorithms use biologically inspired techniques such as genetic inheritance, natural selection, mutation, and sexual reproduction (recombination, or crossover). Along with genetic programming (GP), they are one of the main classes of genetic and evolutionary computation (GEC) methodologies.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

GA consists of a data structure of individuals called Population. Individuals are also called as chromosomes. Each individual is represented by usually the binary strings. Each individual represents a point in the search space and a solution candidate. The individuals in the population are then exposed to the process of evolution Initial population is generated randomly. The consecutive generations are created using the parents from the previous generation. Two parents are selected for reproduction using recombination. Recombination consists of two genetic operators namely 1) crossover and 2) mutation. Newly generated individuals are tested for fitness based on the cost function and the best survives for the next generation. Genes from good individuals propagate throughout the population thus making the successive generations become more suited to the environment.

Holland laid the foundation of formulating the Simple Genetic algorithm (SGA)[21] during 1960-1970. But the application of this algorithm has been realized only after Goldberg's studies [24] and this algorithm has been applied to many classification and performance evaluations. R.L.Haupt has done much research on electromagnetics and antenna arrays using GA [13]-[15].

The important parameters are

• **Crossover** – exchange of genetic material (substrings) denoting rules, structural components, features of a machine learning, search, or optimization problem

• **Selection** – the application of the fitness criterion to choose which individuals from a population will go on to reproduce

• **Reproduction** – the propagation of individuals from one generation to the next

• **Mutation** – the modification of chromosomes for single individuals

Current GA theory consists of two main approaches – Markov chain analysis and schema theory. Markov chain analysis is primarily concerned with characterizing the stochastic dynamics of a GA system, *i.e.*, the behavior of the random sampling mechanism of a GA over time. The most severe limitation of this approach is that while crossover is easy to implement, its dynamics are difficult to describe mathematically. Markov chain analysis of simple GAs has therefore been more successful at capturing the behavior of evolutionary algorithms with selection and mutation only. These include evolutionary algorithms (EAs) and evolutionary strategies. A schema is a generalized description or a conceptual system for understanding knowledge-how knowledge is represented and how it is used. According to this theory, schemata represent knowledge about concepts: objects and the relationships they have with other objects, situations, events, sequences of events, actions, and sequences of actions.

III. MODEL OF AN ANTENNA ARRAY

An incident plane wave causes a linear gradient time delay between the antenna elements that is proportional to the angle of incidence. This time delay along the array manifests as a progressive phase shift between the elements when it is projected onto the sinusoidal carrier frequency. In the special case of normal incidence of the plane wave, all the antennas receive exactly the same signal, with no time delay or phase shift.

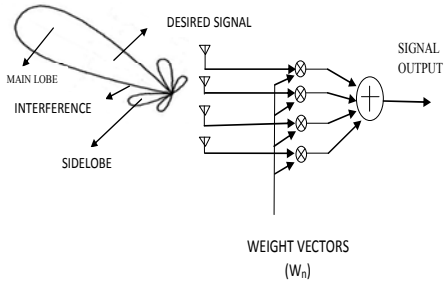


Figure 1: Antenna Array

In this work the antenna elements are assumed to be uniformly spaced, in a straight line along the y-axis, and N is always the total number of elements in the antenna array. The physical separation distance is *d*, and the wave number of the carrier signal is $k = 2\pi/\lambda$. The product *kd* is then the separation between the antennas in radians. When *kd* is equal to π (or $d = \lambda/2$) the antenna array has maximum gain with the greatest angular accuracy with no grating lobes. The phase shift between the elements experienced by the plane wave is $kd\cos\theta$ and θ is measured from the y-axis, starting from the first antenna, as shown in Figure1. Weights can be applied to the individual antenna signals before the array factor (AF) is formed to control the direction of the main beam. This corresponds to a multiple-input-single-output (MISO) system. The total AF is just the sum of the individual signals, given by [9]

$$AF = \left| \left(\sum_{n=1}^{N} E_n \right) \right| = \sum_{n=1}^{N} e^{jK_n} \quad \ldots\ldots\ldots (1)$$

The factor $K = (nkd\cos\theta + \beta_n)$ is the phase difference. Final simplification of equation (1) is by conversion to phasor notation. Only the magnitude of the AF in any direction is important, the absolute phase has no

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

bearing on the transmitted or received signal. Therefore, only the relative phases of the individual antenna signals are important in calculating the AF. Any signal component that is common to all of the antennas has no effect on the magnitude of the AF.

IV. PROBLEM FORMULATION

Consider an array of antenna consisting of N number of elements. It is assumed that the antenna elements are symmetric about the center of the linear array. The far field array factor of this array with an even number of isotropic elements (2N) can be expressed as

$$AF(\theta) = 2\sum_{n=1}^{N} a_n \cos\left(a\frac{\pi}{\lambda} d_n \sin\theta\right) \quad \ldots\ldots\ldots\ldots (2)$$

Where a_n is the amplitude of the n^{th} element, θ is the angle from broadside and d_n is the distance between position of the n^{th} element and the array center. The main objective of this work is to find an appropriate set of required element amplitude a_n that achieves interference suppression with maximum sidelobe level reduction.

To find a set of values which produces the array pattern, the algorithm is used to minimize the following cost function

$$cf = \sum_{\theta=-90^\circ}^{90^\circ} W(\theta)\left[F_\circ(\theta) - F_d(\theta)\right] \quad \ldots. (3)$$

Where $F_0(\theta)$ is the pattern obtained using our algorithm and $F_d(\theta)$ is the pattern desired. Here it is taken to be the Chebychev pattern with SLL of -13dB and $W(\theta)$ is the weight vector to control the sidelobe level in the cost function. The value of cost function is to be selected based on experience and knowledge.

V. RESULTS AND DISCUSSION

The antenna model consists of 20 elements and equally spaced with d =0.5λ along the y-axis. Voltage sources are at the center segment of each element and the amplitude of the voltage level is the antenna element weight. Only the voltage applied to the element is changed to find the optimum amplitude distribution, while the array geometry and elements remain constant. A continuous GA with a population size 10 and a mutation rate of 0.35 is run for a total of 500 generations using MATLAB and the best result is found for each iteration. The cost function is the minimum sidelobe level for the antenna pattern. Figure 2 shows that the antenna array with N = 8 elements has been normalized for a gain of 0dB along the angle 0° and the maximum relative side lobe level of -15dB.

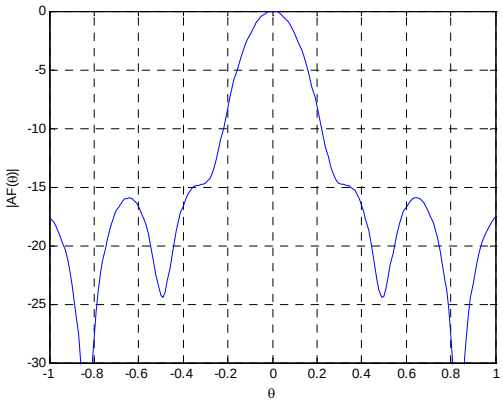


Figure 2: Optimized Radiation pattern with reduced sidelobe level of -15dB for N=8 elements.

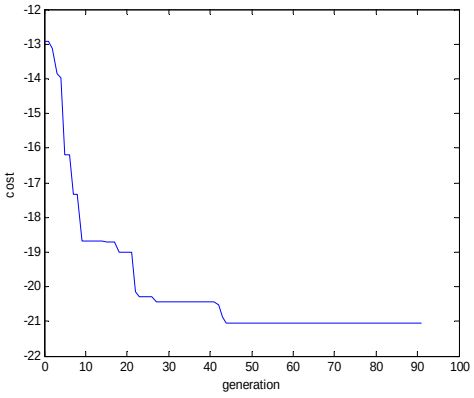


Figure 3: Convergence of sidelobe level with respect to evolving generations for N=8 elements.

Figure 3 shows the convergence of the algorithm for maximum reduction in the relative sidelobe level with N = 8 elements. It starts from -13dB which is the optimized value of Chebychev Pattern for the RSLL and after 8 iterations it reaches -18.8dB and after 43 generations it converges to a maximum reduction of -21dB. Figure 4 shows the optimized radiation pattern with relative sidelobe level of -15dB with N=16 and Figure 5 shows its convergence curve. The convergence curve shows that it converges to -19.3dB after 54 generations. Changing the number of elements causes the contiguous GA to get different optimum weights. Among N=8, 16, 20, and 24, N=20 performed well and thus selected as optimized element number. The corresponding array pattern for N=8,16,20, and 24 are shown in Figure 5. In this the radiation pattern for N=20 has the best directivity with minimum relative sidelobe level of -14.67dB below the main beam. Figure 6 and Figure7 show the convergence of sidelobe level for N=16 and 20 respectively. Figure8 and Figure10 show the optimized radiation pattern with relative sidelobe level of -18.7dB with N=20 and RSLL of -14.97dB

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

with N=24 elements respectively. Fig 9 shows the convergence curve for N=24 elements.

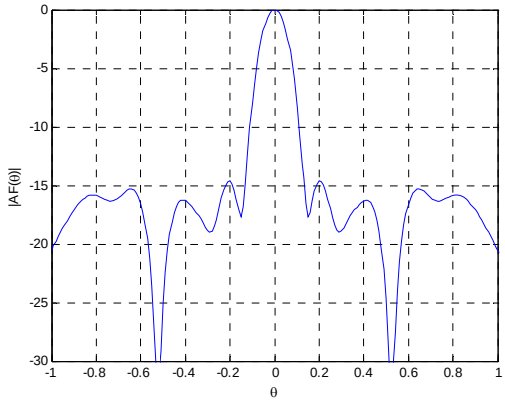


Figure 4: Optimized Radiation pattern with reduced sidelobe level of -15 dB for N = 16 elements

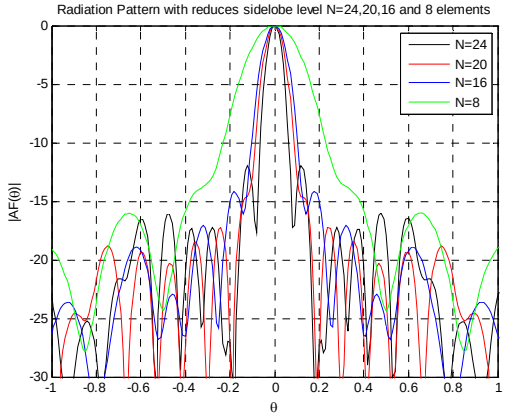


Figure 5 : The optimized radiation pattern with reduced sidelobe level for N=8,16,20,and 24

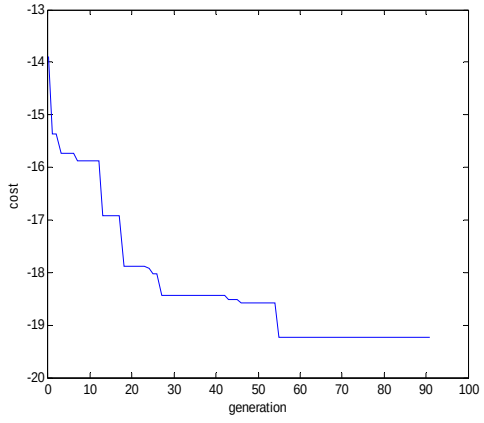


Figure 6: Convergence of sidelobe level with respect to evolving generations for N=16 elements.

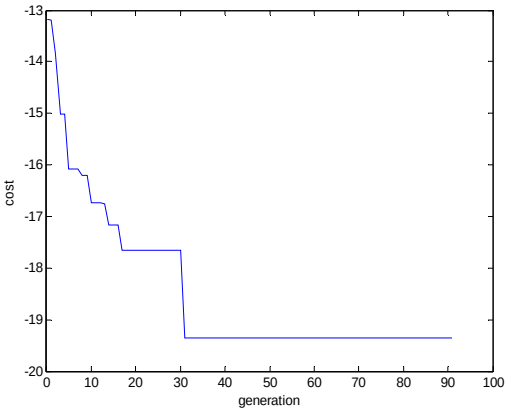


Figure 7: Convergence of sidelobe level with respect to evolving generations for N=20 elements.

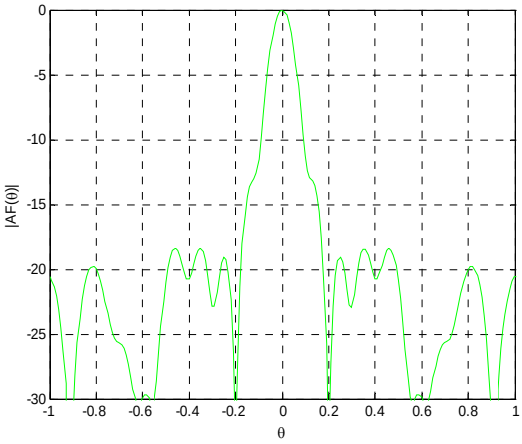


Figure 8: The optimized radiation pattern with reduced sidelobe level for number of elements N = 20

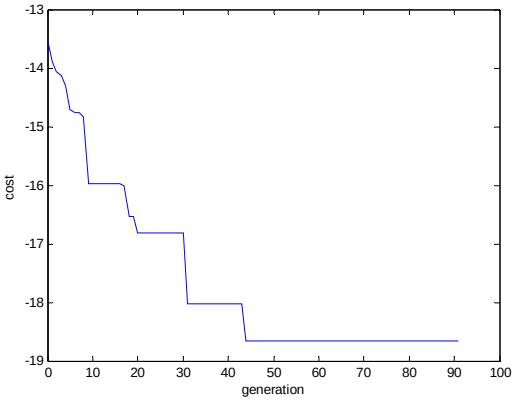


Figure 9: Convergence of sidelobe level with respect to evolving generations for N=24 elements.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

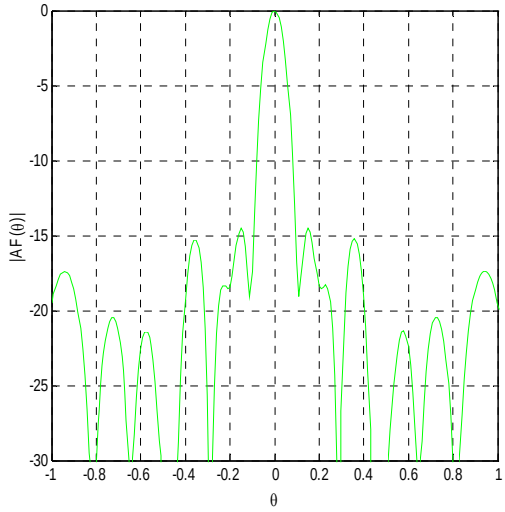


Figure 10: The optimized radiation pattern with reduced sidelobe level for number of elements N= 24

The obtained costs are ranked from best to worst. The most among suitability criteria is to discard the bottom half and to keep the top half of the list. But in our program the selection criteria is to discard any chromosome that has relative sidelobe level less than -15dB. The cost function relative to the population that has a SLL less than -15 dB. Among 10 populations only 5 are selected. This limitation speeds up the convergence of the algorithm. After this natural selection the chromosomes mate to produce offsprings. Mating takes place by pairing the surviving chromosome. Once paired, the offspring consists of genetic material from both parents

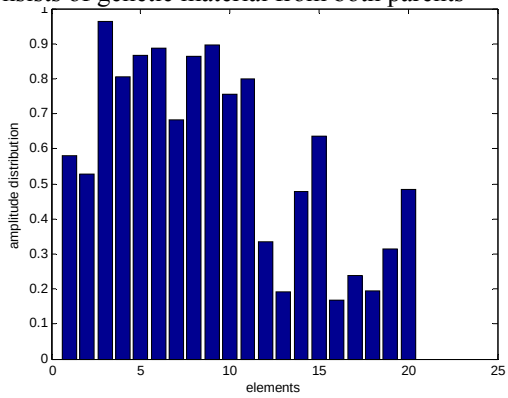


Figure 11: Amplitude distribution for optimized antenna array with N=20 elements

Figure 11 shows the amplitude excitation for optimized antenna array.

The Genetic algorithm has many variables to control and trade-offs to consider.

1) Number of Chromosomes and initial random Population, more number of chromosomes provide better sampling number, solution space but at the cost of slow convergence.
2) Generating the random list, the type of probability distribution and weighting of the parameters has a significant impact on the convergence time.
3) Natural selection method is employed to decide which chromosome to discard.
4) Crossover the chromosome for mating, the chromosome may be paired from top to bottom randomly best to worst.
5) Mutation rate is selected to mutate a particular chromosome. Mutate does not permit the algorithm to get stuck at local minimum.
6) Stopping Criteria, set in this program are maxgen = 500, maxfun = 1000 and mincost = -50dB.

In this paper the Genetic Algorithm has converged well for a variant of options mentioned above with some trade offs to have main impact on convergence speed.

VI. CONCLUSION

In this paper Genetic algorithm is used to obtain minimum sidelobe level relative to the main beam on both sides of 0°. The specialty of the Genetic algorithm is that it can optimize the large number of discrete parameters. Genetic algorithm is an intellectual algorithm searches for the optimum element weight of the array antenna. This paper demonstrated the different ways to apply Genetic algorithm by varying the values of mutation, population size, number of elements to optimize the array pattern. The best obtained results are explained in the previous sections.

REFERENCES

[1] M.A.Panduro, "Design of Non-Uniform Linear Phased Arrays using Genetic Algorithm To Provide Maximum Interference Reduction Capability in a Wireless Communication System", Journal of the Chinese Institute of Engineers,Vol.29 No.7,pp 1195-1201(2006).

[2] Stephen Jon Blank, "On the Empirical optimization of Antenna Arrays", IEEE antenna and Propagation Magazine, 47, 2, pp.58-67, April 2005.

[3] Aniruddha Basak.et.al, "A Modified Invasive Weed Optimized Algorithm for Time- Modulated Linear Antenna Array Synthesis", IEEE Congress on Evolutionary Computation (CEC) DOI:10.1109/CEC.2010.5586276 pp.1-8 2010.

[4]. Aritra Chowdhury et.al. "Linear Antenna Array Synthesis using Fitness-Adaptive Different Evolution Algorithm", IEEE Congress on Evolutionary Computation (CEC) 2010 pp.1-8,DOI.2010/5586518.

[5] T.B.Chen,Y,B.Chen,Y.C.Jiao and F.S.Zhang, "Synthesis of Antenna Array Using Particle Swarm Optimization", Asia-Pacific

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Conference proceedings on Microwave Conference,2005 ,APMC,2005,pp.4.
[6] Peiging Xia and Mounir Ghogho, "Evaluation of Multiple Effects Interference Cancellation in GNSS using Space-Time based Array Processing", International Journal of Control, Automation, and Systems, vol. 6, no. 6, pp. 884-893, December 2008.
[7] Aniruddha Basak, Siddharth Pal, Swagatam Das, Ajith Abraham, "Circular Antenna Array Synthesis with a Different invasive Weed Optimization Algorithm", Progress In Electromagnetics Research, PIER 79, pp.137–150, 2008.
[8] Oscar Quevedo-Teruel and Eva Rajo-Iglesias, "Application of Ant Colony Optimization Algorithm to solve Different Electromagnetic Problems", Proc.EuCAP 2006, Nice, France 6-10 November 2006.
[9] Peter J.Bevelacqua and Constantine A.Balanis, "Optimizing Antenna Array Geometry for Interference Suppression", IEEE Transaction on Antenna And Propagation, Vol.55, no.3 pp 637-641, March 2007.
[10] Stephen J.Blank, "Antenna Array Synthesis Using Derivative, Non-Derivative and Random Search Optimization", IEEE Sarnoff Symposium, DOI 10.1109/SARNOF. 2008.4520115, pp 1-40, April 2008.
[11] Korany R. Mahmoud,et.al., "Analysis of Uniform Circular Arrays for Adaptive Beamforming Application Using Particle Swarm Optimization Algorithm", International Journal of RF and Microwave Computer–Aided Engineering DOI 101.1002 pp.42-52.
[12] David E.Goldberg, John H.Holland, "Genetic Algorithm and Machine Learning", Kluwer Academic Publishers, Machine Learning 3: pp 95-99, 1998.
[13] R.L.Haupt, "Directional Antenna System Having Sidelobe Suppression, Us Patent 4, pp571-594 Feb 18, 1986.
[14] R.L.Haupt, "Thinned arrays using genetic algorithm", IEEE Transaction on Antenna and Propagation, 42 pp 993-999 July1994.
[15] R.L.Haupt, "Adaptive Nulling With Weight Constraints", Progress In Electromagnetics Research B, Vol. 26, pp 23-38, 2010
[16] C.L.Dolph, "A current distribution for broadside arrays which optimizes the relationship between beam width and side-lobe level," Proc IRE 34 pp3335-348 June 1946.
[17] T.T Taylor,"Design of line source antennas for narrow beamwidth and side lobes", IRE AP Trans 4 pp 16-28 Jan 1955.
[18] R.S.Elliot, "Antenna Theory and Design", Prentice-Hall, New York 1981.
[19]A.T.Villeneuve, Taylor, "Patterns for discrete patterns arrays", IEEE AP˜ Trans 32(10) pp 1089-1094 October 1984.
[20] W.W.Hansen and J.R.Woodyard, "A new principle in directional antenna design", Proc,IRE 26 pp333-345 March 1938.
[21] E.T.Bayliss, "Design of Monopulse Antenna difference Pattern with low sidelobe level", Bell Syst. Tech.J.47 pp623-650 May-June 1968.
[22] W.L.Stutzman nd E.L Coffey, "Radiation pattern synthesis of planar antennas using the iterative sampling method", IEEE Transactions on Antenna and Propagation, 23(6) pp762-769 November 1975.
[23] J.H.Holland, "Adaptation in Natural and Artificial Systems", Univ. Michigan Press, Ann Arbor ,1975.
[24] D.E.Goldberg, "Genetic Algorithm in search optimization and Machine Learning Addison-Wesley, New York,1989.
[25] B.Widrow et.al., "Adaptive antenna system", IEEE. Proc 55(12) , pp2143-2159 Dec 1967.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

An Efficient Constrained K-Means Clustering using Self Organizing Map

M.Sakthi[1] and Dr. Antony Selvadoss Thanamani[2]

[1]Research Scholar [2]Associate Professor and Head, Department of Computer Science, NGM College, Pollachi, Tamilnadu.

***Abstract*---** The rapid worldwide increase in the data available leads to the difficulty for analyzing those data. Organizing data into interesting collection is one of the most basic forms of understanding and learning. Thus, a proper data mining approach is required to organize those data for better understanding. Clustering is one of the standard approaches in the field of data mining. The main of this approach is to organize a dataset into a set of clusters, which consists of similar data items, as calculated by some distance function. K-Means algorithm is the widely used clustering algorithm because of its ability and simple nature. When the dataset is larger, K-Means will misclassify the data points. For overcoming this problem, some constraints must be included in the algorithm. The resulting algorithm is called as Constrained K-Means Clustering. The constraints used in this paper are Must-link constraint, Cannot-link constraint, δ-constraint and ε-constraint. For generating the must-link and cannot-link constraints, Self Organizing Map (SOM) is used in this paper. The experimental result shows that the proposed algorithm results in better classification than the standard K-Means clustering technique.

***Keywords*---** K-Means, Self Organizing Map (SOM), Constrained K-Means

I. INTRODUCTION

THE growth and development in sensing and storage technology and drastic development in the applications such as internet search, digital imaging, and video surveillance have generated many high-volume, high-dimensional data sets. As the majority of the data are stored digitally in electronic media, they offer high prospective for the development of automatic data analysis, classification, and retrieval approaches.

Clustering is one of the most popular approaches used for data analysis and classification. Cluster analysis is widely used in disciplines that involve analysis of multivariate data. A search through Google Scholar found 1,660 entries with the words data clustering that comes into sight in 2007 alone. This huge amount of data provides the significance of clustering in data analysis. It is very complex to list the different scientific fields and applications that have utilized clustering method as well as the thousands of existing techniques.

The main aim of data clustering is to identify the natural classification of a set of patterns, points, or objects. Webster defines cluster analysis as "a statistical classification method for discovering whether the individuals of a population fall into various groups by making quantitative comparisons of multiple characteristics". The another definition of clustering is: Provided a representation of n objects, determine K groups according to the measure of similarity like similarities among objects in the same group are high whereas the similarities between objects in different groups are low.

The main advantages of using the clustering algorithms are:

- Compactness of representation.
- Fast, incremental processing of new data points.
- Clear and fast identification of outliers.

The widely used clustering technique is K-Means clustering. This is because K-Means is very simple to implement and also it is effective in clustering. But K-Means clustering will lack performance when large dataset is involved for clustering. This can be solved by including some constraints [8, 9] in the clustering algorithm; hence the resulting clustering is called as Constrained K-Means Clustering [7, 10]. The constraints used in this paper are Must-link constraint, Cannot-link constraint [14, 16], δ-constraint and ε-constraint. Self Organizing Map (SOM) is used in this paper for generating the must-link and cannot-link constraints.

II. RELATED WORKS

Zhang Zhe *et al.,* [1] proposed an improved K-Means clustering algorithm. K-means algorithm [8] is extensively utilized in spatial clustering. The mean value of each cluster centroid in this approach is taken as the Heuristic information, so it has some limitations such as sensitive to the initial centroid and instability. The enhanced clustering algorithm referred to the best clustering centroid which is searched during the optimization of clustering centroid. This increases

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

the searching probability around the best centroid and enhanced the strength of the approach. The experiment is performed on two groups of representative dataset and from the experimental observation, it is clearly noted that the improved K-means algorithm performs better in global searching and is less sensitive to the initial centroid.

Hai-xiang Guo *et al.,* [2] put forth an Improved Genetic k-means Algorithm for Optimal Clustering. The value of k must be known in advance in the traditional k-means approach. It is very tough to confirm the value of k accurately in advance. The author proposed an enhanced genetic k-means clustering (IGKM) and builds a fitness function defined as a product of three factors, maximization of which guarantees the formation of a small number of compact clusters with large separation between at least two clusters. Finally, the experiments are conducted on two artificial and three real-life data sets that compare IGKM with other traditional methods like k-means algorithm, GA-based technique and genetic k-means algorithm (GKM) by inter-cluster distance (ITD), inner-cluster distance (IND) and rate of separation exactness. From the experimental observation, it is clear that IGKM reach the optimal value of k with high accuracy.

Yanfeng Zhang *et al.,* [3] proposed an Agglomerative Fuzzy K-means clustering method with automatic selection of cluster number (NSS-AKmeans) approach for learning optimal number of clusters and for providing significant clustering results. High density areas can be detected by the NSS-AKmeans and from these centers the initial cluster centers with a neighbor sharing selection approach can also be determined. Agglomeration Energy (AE) factor is proposed in order to choose a initial cluster for representing global density relationship of objects. Moreover, in order to calculate local neighbor sharing relationship of objects, Neighbors Sharing Factor (NSF) is used. Agglomerative Fuzzy k-means clustering algorithm is then utilized to further merge these initial centers to get the preferred number of clusters and create better clustering results. Experimental observations on several data sets have proved that the proposed clustering approach was very significant in automatically identifying the true cluster number and also providing correct clustering results.

Xiaoyun Chen *et al.,* [4] described a GK-means: an efficient K-means clustering algorithm based on grid. Clustering analysis is extensively used in several applications such as pattern recognition, data mining, statistics etc. K-means approach, based on reducing a formal objective function, is most broadly used in research. But, user specification is needed for the k number of clusters and it is difficult to choose the effective initial centers. It is also very susceptible to noise data points. In this paper, the author mainly focuses on option the better initial centers to enhance the quality of k-means and to minimize the computational complexity of k-means approach. The proposed GK-means integrates grid structure and spatial index with k-means clustering approach. Theoretical analysis and experimental observation show that the proposed approach performs significantly with higher efficiency.

Trujillo *et al.,* [5] proposed a combining K-means and semivariogram-based grid clustering approach. Clustering is widely used in various applications which include data mining, information retrieval, image segmentation, and data classification. A clustering technique for grouping data sets that are indexed in the space is proposed in this paper. This approach mainly depends on the k-means clustering technique and grid clustering. K-means clustering is the simplest and most widely used approach. The main disadvantage of this approach is that it is sensitive to the selection of the initial partition. Grid clustering is extensively used for grouping data that are indexed in the space. The main aim of the proposed clustering approach is to eliminate the high sensitivity of the k-means clustering approach to the starting conditions by using the available spatial information. A semivariogram-based grid clustering technique is used in this approach. It utilizes the spatial correlation for obtaining the bin size. The author combines this approach with a conventional k-means clustering technique as the bins are constrained to regular blocks while the spatial distribution of objects is irregular. An effective initialization of the k-means is provided by semivariogram. From the experimental results, it is clearly observed that the final partition protects the spatial distribution of the objects.

Huang *et al.,* [6] put forth the automated variable weighting in k-means type clustering that can automatically estimate variable weights. A novel approach is introduced to the k-means algorithm to iteratively update variable weights depending on the present partition of data and a formula for weight calculation is also proposed in this paper. The convergency theorem of the new clustering algorithm is given in this paper. The variable weights created by the approach estimates the significance of variables in clustering and can be deployed in variable selection in various data mining applications where large and complex real data are often used. Experiments are conducted on both synthetic and real data and it is found from the experimental observation that the proposed approach provides higher performance when compared the traditional k-means type algorithms in recovering clusters in data.

III. METHODOLOGY

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

The methodology proposed for clustering the data is presented in this section. Initially, K-Means clustering is described. Then the constraint based K-Means clustering is provided. Next, the constraints used in Constrained K-Means algorithm are presented. For the generation of constraints like must-link and cannot-link, Self Organizing Map is used in this paper.

K-Means Clustering

Provided a data set of data samples, a preferred number of clusters, k, and a set of k initial starting points, the k-means clustering technique determines the desired number of distinct clusters and their centroids. A centroid is defined as the point whose coordinates are determined by calculating the average of each of the coordinates (i.e., feature values) of the points of the jobs allocated to the cluster. Properly, the k-means clustering algorithm follows the following steps.

Step 1: Choose a number of desired clusters, k.

Step 2: Choose k starting points to be used as initial estimates of the cluster centroids. These are the initial starting values.

Step 3: Examine each point in the data set and assign it to the cluster whose centroid is nearest to it.

Step 4: When each point is assigned to a cluster, recalculate the new k centroids.

Step 5: Repeat steps 3 and 4 until no point changes its cluster assignment, or until a maximum number of passes through the data set is performed.

Constrained K-Means Clustering

Constrained K-Means Clustering [15] is similar to the standard K-Means Clustering algorithm with the exception is that the constraints must be satisfied while assigning the data points into the cluster. The algorithm for Constrained K-Means Clustering is described below.

Step 1: Choose a number of desired clusters, k.

Step 2: Choose k starting points to be used as initial estimates of the cluster centroids. These are the initial starting values.

Step 3: Examine each point in the data set and assign it to the cluster whose centroid is nearest to it only when the *violate-constraints ( )* returns *false*

Step 4: When each point is assigned to a cluster, recalculate the new k centroids.

Step 5: Repeat steps 3 and 4 until no point changes its cluster assignment, or until a maximum number of passes through the data set is performed.

Function violate-constraints ( )

if must_link constraint not satisfied

return true

elseif cannot_link constraint not satisfied

return true

elseif δ-constraint not satisfied

return true

elseif ε-constraint not satisfied

return true

else

return false

Constraints used for Constrained K-Means Clustering

The Constraints [11, 12, 13] used for Constrained K-Means Clustering are

- Must-link constraint
- Cannot-link constraint
- δ-constraint
- ε-constraint

Consider $S = \{s_1, s_2, \ldots, s_n\}$ as a set of n data points that are to be separated into clusters. For any pair of points s_i and s_j in S, the distance between them is represented by $d(s_i, s_j)$ with a symmetric property in order that $d(s_i, s_j) = d(s_j, s_i)$. The constraints are:

- *Must-link constraints* indicates that two points s_i and s_j $(i \neq j)$ in S have to be in the same cluster.
- *Cannot-link constraints* indicates that two point s_i and s_j $(i \neq j)$ in S must not be placed in the same cluster.
- *δ-Constraint:* This constraint represents a value $\delta > 0$. Properly, for any pair of clusters S_i and S_j $(i \neq j)$, and any pair of points s_p and s_q such that $s_p \in S_i$ and $s_q \in S_j$, $d(s_p, s_q) \geq \delta$.
- *ε-Constraint:* This constraint represents a value $\varepsilon > 0$ and the feasibility need is the following: for any cluster S_i containing two or more points and for any point $s_p \in S_i$, there must be another point $s_q \in S_i$ such that $d(s_p, s_q) \leq \varepsilon$.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Must-link constraint and Cannot-link constraint are determined with the help of appropriate neural network. For this purpose, this paper uses Self Organizing Map.

Self Organizing Map

Self-Organizing Maps (SOM) is a general type of neural network technique that is nonlinear regression method that can be utilized to determine relationships among inputs and outputs or categorize data so as to reveal so far unidentified patterns or structures. It is an outstanding technique in exploratory phase of data mining. The results of the examination represents that self-organizing maps can be a feasible technique for categorization of large quantity of data. The SOM has set up its place as an expensively used technique in data-analysis and visualization of high-dimensional data. Among other statistical technique the SOM has no close counterpart, and thus it offers a balancing sight to the data. On the other hand, SOM is the most extensively used technique in this group as it offers some notable merits among the substitutes. These comprise, ease of use, particularly for inexperienced users, and highly intuitive display of the data anticipated on to a regular two-dimensional slab, as on a sheet of a paper. The most important prospective of the SOM is in exploratory data analysis that varies from regular statistical data analysis in that there are no assumed set of hypotheses that are validated in the analysis. As an alternative, the hypotheses are created from the data in the data-driven exploratory stage and validated in the confirmatory stage. There are few demerits where the exploratory stage may be adequate alone, such as visualization of data with no additional quantitative statistical inference upon it. In practical data analysis problems the majority of mission is to identify dependencies among variables. In such a difficulty, SOM can be utilized for getting insight to the data and for the original search of potential dependencies. In general the findings require to be validated with more conventional techniques, for the purpose of assessing the assurance of the conclusions and to discard those that are not statistically important.

Initially the chosen parameters are normalized and then initialize the SOM network. Then SOM is trained to offer the maximum likelihood estimation, so that an exacting stock can be linked with a particular node in the categorization layer. The self-organizing networks suppose a topological structure between the cluster units. There are m cluster units, prearranged in a one or two dimensional array: the input signals are n dimensional. Figure 1 represents architecture of self-organizing network (SOM) that consists of input layer, and Kohonen or clustering layer.

Finally the categorized data is obtained from the SOM. From this obtained categorized data, must link and cannot link constraints are derived. The data points in a cluster are considered as must link constraint and data points outside the clusters are considered as cannot link constraints. These constraints are used in the constraints checking module of constrained K-Means algorithm.

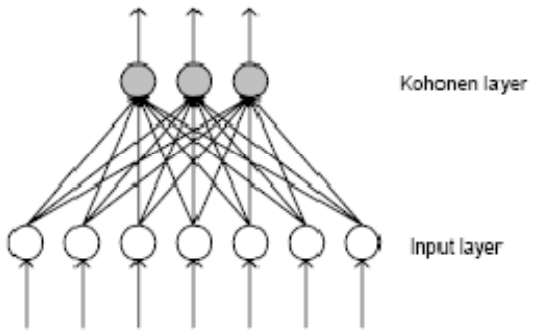


Figure 1: Architecture of self-organizing map

IV. EXPERIMENTAL RESULTS

The proposed technique is experimented using the two benchmark datasets which are Iris and Wine Dataset from the UCI machine learning Repository [17]. All algorithms are implemented under the same initial values and stopping conditions. The experiments are all performed on a GENX computer with 2.6 GHz Core (TM) 2 Duo processors using MATLAB version 7.5.

Experiment with Iris Dataset

The Iris flower data set (Fisher's Iris data set) is a multivariate data set. The dataset comprises of 50 samples from each of three species of Iris flowers (Iris setosa, Iris virginica and Iris versicolor). Four features were measured from every sample; they are the length and the width of sepal and petal, in centimeters. Based on the combination of the four features, Fisher has developed a linear discriminant model to distinguish the species from each other. It is used as a typical test for many classification techniques. The proposed method is tested first using this Iris dataset. This database has four continuous features consisting of 150 instances: 50 for each class.

To evaluate the efficiency of the proposed approach, this technique is compared with the existing K-Means algorithm. The Mean Square Error (MSE) of the centers $MSE = \sqrt{||v_c - v_t||^2}$ where v_c is the computed center and v_t is the true center. The cluster centers found by the proposed K-Means are closer to the true centers, than the centers found by K-Means algorithm. The mean square error for the four cluster centers for the two approaches are presented in table I. The

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

resulted execution for the proposed and standard K-Means algorithms is provided in figure 2.

TABLE I

MEAN SQUARE ERROR VALUE OBTAINED FOR THE THREE CLUSTERS IN THE IRIS DATASET

	K-Means	Proposed K-Means
Cluster 1	0.3765	0.2007
Cluster 2	0.4342	0.2564
Cluster 3	0.3095	0.1943

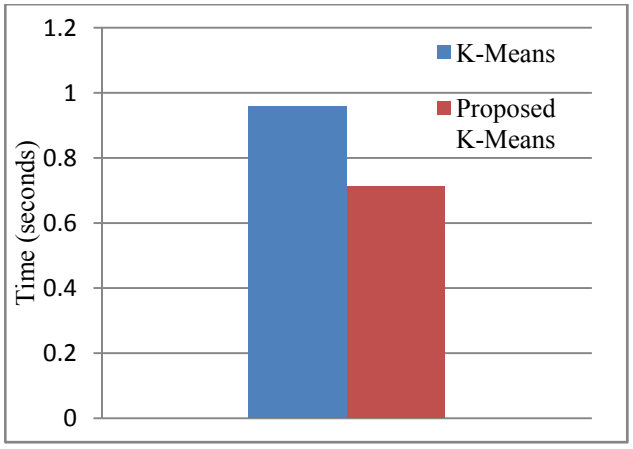


Figure 2: Execution Time for Iris Dataset

Experiment with Wine Dataset

The wine dataset is the results of a chemical analysis of wines grown in the same region in Italy but derived from three different cultivars. The analysis established the quantities of 13 constituents found in each of the three types of wines. The classes 1, 2 and 3 have 59, 71 and 48 instances respectively. There are totally 13 Number of Attributes.

The MSE value for the three clusters is presented in Table II. The resulted execution for the proposed and standard K-Means algorithms is provided in figure 2.

TABLE II

MEAN SQUARE ERROR VALUE OBTAINED FOR THE THREE CLUSTERS IN THE WINE DATASET

	K-Means	Proposed K-Means
Cluster 1	0.4364	0.3094
Cluster 2	0.5562	0.3572
Cluster 3	0.2142	0.1843

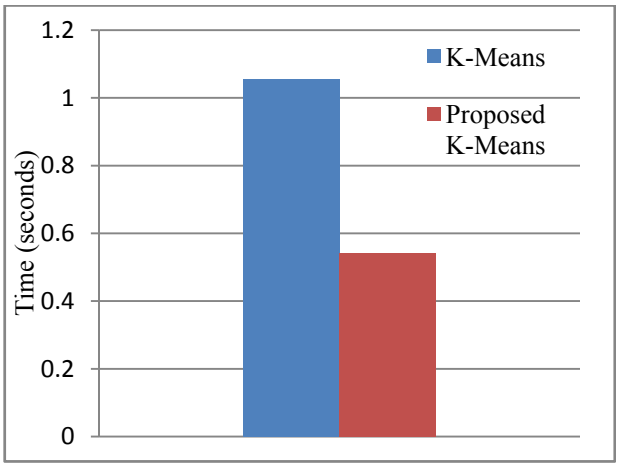


Figure 3: Execution Time for Wine Dataset

From the experimental observations it can be found that the proposed approach produces better clusters than the existing approach. The MSE value is highly reduced for both the dataset. This represents the better accuracy for the proposed approach. Also, the execution time is reduced when compared to the existing approach. This is true in both the dataset.

V. CONCLUSION

The increase in the number of data world wide leads to the requirement for the better analyzing technique for better understanding of data. One of the most essential modes of understanding and learning is categorizing data into reasonable groups. This can be achieved by a famous data mining technique called Clustering. Clustering is nothing but separating the given data into particular groups according to the separation among the data points. This will helps in better understanding and analyzing of the vast data. One of the widely used clustering is K-Means clustering because it is simple and efficient. But it lacks accuracy of classification when large data are used in clustering. So the K-Means clustering needs to be improved to suit for all kinds of data. Hence the new clustering technique called Constrained K-Means Clustering is introduced. The constraints used in this paper are Must-link constraint, Cannot-link constraint, δ-constraint and ε-constraint. SOM is used in this paper for generating Must-link and Cannot-link constraints. The experimental result shows that the proposed technique results in better classification and also takes lesser time for

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

classification. In future, this work can be extended by using more suitable constraints in the Constrained K-Means Clustering technique.

REFERENCES

[1] Zhang Zhe, Zhang Junxi and Xue Huifeng, "Improved K-Means Clustering Algorithm", Congress on Image and Signal Processing, Vol. 5, Pp. 169-172, 2008.

[2] Hai-xiang Guo, Ke-jun Zhu, Si-wei Gao and Ting Liu, "An Improved Genetic k-means Algorithm for Optimal Clustering", Sixth IEEE International Conference on Data Mining Workshops, Pp. 793-797, 2006.

[3] Yanfeng Zhang, Xiaofei Xu and Yunming Ye, "NSS-AKmeans: An Agglomerative Fuzzy K-means clustering method with automatic selection of cluster number", 2nd International Conference on Advanced Computer Control, Vol. 2, Pp. 32-38, 2010.

[4] Xiaoyun Chen, Youli Su, Yi Chen and Guohua Liu, "GK-means: an Efficient K-means Clustering Algorithm Based on Grid", International Symposium on Computer Network and Multimedia Technology, Pp. 1-4, 2009.

[5] Trujillo, M., Izquierdo, E., "Combining K-means and semivariogram-based grid clustering", 47th International Symposium, Pp. 9-12, 2005.

[6] Huang, J.Z., Ng, M.K., Hongqiang Rong and Zichen Li, "Automated variable weighting in k-means type clustering", IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 27, No. 5, Pp. 657-668, 2005.

[7] Yi Hong and Sam Kwong "Learning Assignment Order of Instances for the constrained k-means clustering algorithm" IEEE Transactions on Systems, Man, and Cybernetics, Vol 39, No 2. April, 2009.

[8] I. Davidson,M. Ester and S.S. Ravi, "Agglomerative hierarchical clustering with constraints: Theoretical and empirical results", in Proc. of Principles of Knowledge Discovery from Databases, PKDD 2005.

[9] Wagstaff, Kiri L., Basu, Sugato, Davidson, Ian "When is constrained clustering beneficial, and why?" National Conference on Aritficial Intelligence, Boston, Massachusetts 2006.

[10] Kiri Wagstaff, Claire Cardie, Seth Rogers, Stefan Schrodl "Constrained K-means Clustering with Background Knowledge" ICML '01 Proceedings of the Eighteenth International Conference on Machine Learning, 2001.

[11] I. Davidson, M. Ester and S.S. Ravi, "Efficient incremental constrained clustering". In Thirteenth ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, 2007, August 12-15, San Jose, California, USA.

[12] I. Davidson, M. Ester and S.S. Ravi, "Clustering with constraints: Feasibility issues and the K-means algorithm", in proc. SIAM SDM 2005, Newport Beach, USA.

[13] D. Klein, S.D. Kamvar and C.D. Manning, "From Instance-Level constraintes to space-level constraints: Making the most of Prior Knowledge in Data Clustering", in proc. 19th Intl. on Machine Learning (ICML 2002), Sydney, Australia, July 2002, p. 307-314.

[14] N. Nguyen and R. Caruana, "Improving classification with pairwise constraints: A margin-based approach", in proc. of the European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECML PKDD'08).

[15] K. Wagstaff, C. Cardie, S. Rogers and S. Schroedl, "Constrained Kmeans clustering with background knowledge", in: Proc. Of 18th Int. Conf. on Machine Learning ICML'01, p. 577 - 584.

[16] Y. Hu, J. Wang, N. Yu and X.-S. Hua, "Maximum Margin Clustering with Pairwise Constraints", in proc. of the Eighth IEEE International Conference on Data Mining (ICDM) , 253-262, 2008.

[17] Merz C and Murphy P, UCI Repository of Machine Learning Databases, Available: ftp://ftp.ics.uci.edu/pub/machine-Learning-databases.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Applying and Analyzing Security using Images

Steganography v.s. Steganalysis

Nighat Mir
Computer Science Department
Effat University
Jeddah, Saudi Arabia
nighat_mir@hotmail.com

Asrar Qadi[2], Wissal Dandachi[2]
Computer Science Department
Effat University
Jeddah, Saudi Arabia
aqadi@effat.edu.sa, wdandachi@effat.edu.sa

Abstract

Steganography is an art of hiding a message in such a way that anyone is unaware of the message's presence. It is an Image processing technique used for hiding information and challenges an eavesdropper to break into a message. Steganography is a Greek work which means "covered writing". Steganalysis in opposite is a technique used to real the hidden messages. Cover images are used to embed information which results as stego images are further introduced on a communication channel for a secret conversation between parties. There are some characteristics in images that must be analyzed to lead us to the existence of a hidden message and identify where to look for the hidden information. Steganalysis is used to analyze if a secret communication is taking place through images. There are different tools for applying and analyzing security using images. In this paper Steganography and Steganalysis both techniques have been practiced and analyzed on images using xiao tool. The xiao tool also has built-in cryptographic algorithms, which adds another layer of security.

Keywords- *Steganography; Steganalysis; cryptography; security; xiao*

I. INTRODUCTION *(DIFFERENT TCHNIQUES)*

There are different methods for information security. Steganograohy and cryptography are two popular techniques but have different behavior.

To control access to content a traditional approach is by using cryptography, in which first data is encoded with a standard compressor and then to perform full encryption of the compressed bit stream with a standard cipher (DES, AES, IDEA, RSA etc.) [1]. A data that can be read and understood without any special measures is called plaintext and when is encrypted into an understandable form is called cipher text. The method of converting plaintext into cipher text is called encryption. The encrypted message is useless for everyone except the person who has the decryption key and algorithm. The process of reverting cipher text to its original plaintext is called decryption.

Steganography differs from cryptography. Cryptography attempts to prevent a message between two parties being decoded by a third party who has intercepted the message. However, cryptography does not prevent the challenger from disturbing the communication channel between the two parties, thereby preventing any further communication. Steganography attempts to hide the very fact that any two parties are conducting a private communication. An adversary may know that the two parties are communicating, but this communication appears to the third party to be a benign communication with no covert subtext. [2]

Steganography uses stego-objects to hide or embed the data into a cover image. Main purpose of Steganography is to guarantee no comprehension that a secret communication is taking place by looking at the cover medium. It aims at hiding data (text, image, audio, video etc.) in such a way that there is no indication of the hidden message. This is achieved by using a cover file and an embedding file. The term "cover" is used to describe the original data and the information to be hidden in the cover data is called "embedded" data. The "stego" contains both cover and embedded data.

The most prevalent cover objects in use are digital images because of their potential payload [3]. A usual digital image of 640x480 pixels can hide approximately 300 KB and a high resolution image can approximately hide 2.3 MB data. Various compression algorithms are available but the three most common are BMP, GIF and JPEG. In our system we have used BMP images as the selected tools only support this type of compression and we have also preferred this tool over other available tools as it supports BMP and GIF which offers lossless compression.

There are many examples of Steganography systems which are generally available to hide the data or information in images i.e. Jsteg, JPhide-works on JPEG and GIF, SecureEngine-hides information in BMP, GIF, HTM, and TXT files.

The main objective of steganography is to converse securely in a completely undetectable manner [4] and to avoid depiction suspicion to the transmission of a hidden data [5]. It is not to keep others from knowing the hidden information, but it is to keep others from thinking that the information even exists. If a steganography method causes

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

someone to suspect the carrier medium, then the method has failed [6].

Steganalysis is a science to detect whether a given medium has hidden message in it. It includes the discovery and destruction of hidden information [1]. Attacks and analysis on hidden information may take several detecting forms i.e. detecting, extracting, disabling or destroying hidden information. An attacker may also embed false or counter information into the hidden image.

It is possible to create a stego image that is not easy to percept with a careful selection of an appropriate cover image and a good stego tool. The Majority of stego-images do not expose visual clues. Once a stego image has been discovered then several attacks can be taken to disable or destroy the hidden message. Determining a secret message is an initial step in steganalysis and is considered as an attack on the hidden information. Second step toward steganalysis is to temper the stego image.

Security, Capacity and Robustness are three important characteristics of information hiding systems. A lot of research has recently focused on using images as a cover for transferring covert messages [7]. Security through obscurity is one of the most trivial types of Steganographic algorithms. It is called so because the main idea is making warden impossible to understand if some communication exists by embedding the data in the unexpected places.

Capacity refers to the amount of information surrounded in the cover file; for the security, it refers to the inability of a third-party to detect hidden information[7].Robustness is hiding the location of presence of the hidden information by creating an information channel with a small bandwidth in a wide data stream.

Steganalysis technique that uses the Compression Bit Rate to detect the secret messages embedded into images degrades quality [6]. The degradation process is modeled as an optical distortion process that shows the document in a degraded state due to printing, photocopying, and/or scanning. Mathematically, it is studied by calculating the probability of flipped foreground/background pixels as function of distance from the boundaries.

Using the compression bit rate quantitative methodology, it will be able to predict the changes in the image with the length of the embedded secret message with the presence of noise imposed by the degradation process. The methodology is based on that the fact that the entropy of the stego signal is higher than the cover signal. Since entropy is unpredictable, using a compression technique could help to estimate the entropy signal, and as a result statistically distinguish the steganalysis of the image [7].

II. METHODOLOGY

There are many tools available for Image Processing techniques for different types of operating systems such as Windows, Dos, Linux, Mac and UNIX. There are differences in tools which should be considered while choosing a tool to perform Steganography and the tool that perform Steganalysis. There are many free tools available on the Internet to perform steganography and Steganalysis. Listed below are few which have tested and analyzed before finalizing the tool which we have used to perform experiments.

http://www.jjtc.com/Steganography/tools.html

http://www.jjtc.com/Steganalysis/

http://xiao-steganography.en.softonic.com/

http://www.dound.com/Progs/Steg.htm

In the studied methodology an existing tool (xiao) is used for applying and analyzing security using images for different types of input data which consists of a text, image, and audio and in video formats. One of the reasons to select this tool was based on the fact that it can apply both of the functions; embedding and extraction. xiao tool is used to apply steganography to secure data using different cryptographic and hashing algorithms (RC2, RC4, DES, 3-DES, MD2, MD4, MD5 and SHA) and it hides information into a bitmap image BMP. This tool also supports Steganalysis to analyze the hidden information on the bitmap images BMP and results into the original image and the hidden file of above mentioned types.

Xiao Steganography runs on Windows OS and we have experimented Version 2.6.01 for our system. It is a user friendly tool to encode a text, audio, video and image into a Bitmap file. User can follow the steps to perform the following; click on add file load the target file, embed secret message, then choose on the cryptographic or hash algorithms and type a password for protection and then save the stego file as a BMP file. We have presented our results in the form of pictures below, before and after applying the security aspects of the image processing. It is very hard to recognize and differentiate between the embedded and original file and stands very well against visual perception.

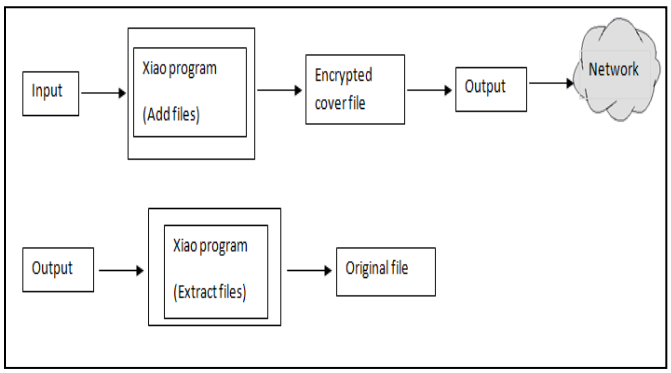


Figure 1. General Block Diagram

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

III. PROPOSED SYSTEM

Different types of multimedia type of data have been used for the experiments and results. We have applied and tested the methodology on following types of cover medium:

1. Securing text in an image file
2. Securing an image in an image file
3. Securing an audio file in an image file
4. Securing a video file in an image file

A. *Experimental Results 1:*

Applying, Steganography on an image for securing a text file.

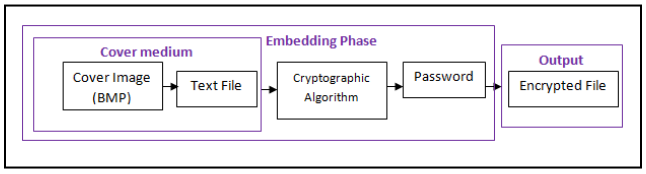


Figure 2. System Diagram to hide a text file

Figure 3. BMP file Original image

Figure 4. BMP file with a hidden text file

A "text file" with a message along "There is a hidden message" is embedded into the original image (figure 1) and the resultant image is shown in figure 2 which reveals no hidden information.

A.1: *Steganalysis: Retrieving the hidden message*

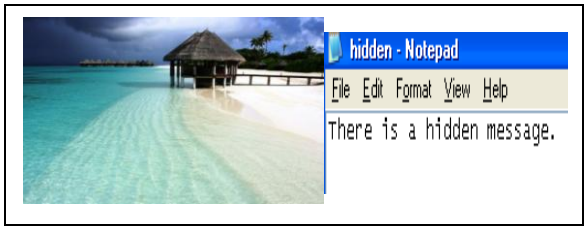


Figure 5. Cover Image (BMP) and Text file

B. *Experimental Results 2:*

Applying, Steganography on an image for securing an image file.

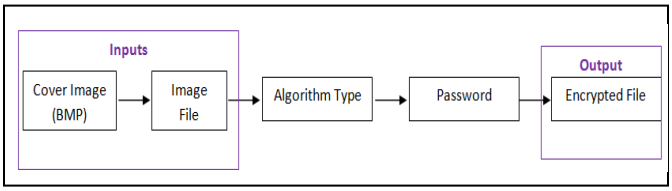


Figure 6. System Diagram to hide an image

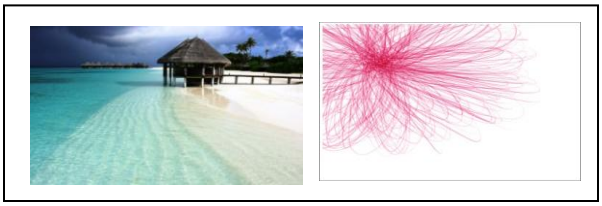


Figure 7. Cover Image (BMP) and Image file(JPG)

B.1: *Steganalysis: Retrieving the hidden message*

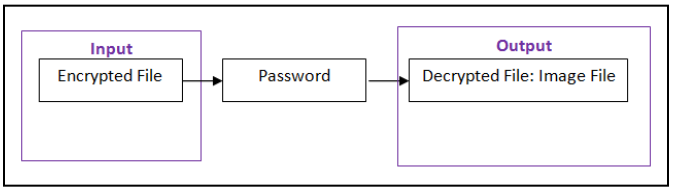


Figure 8. System Diagram to retrieve a hidden image

C. *Experimental Results 3:*

Applying, Steganography on an image for securing an Audio file.

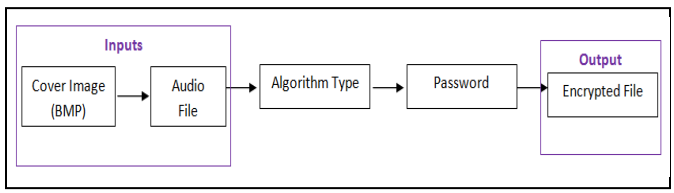


Figure 9. System Diagram to hide an audio file

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Figure 10. Cover Image (BMP) and audio file(MIDI)

C.1: Steganalysis: Retrieving the hidden message

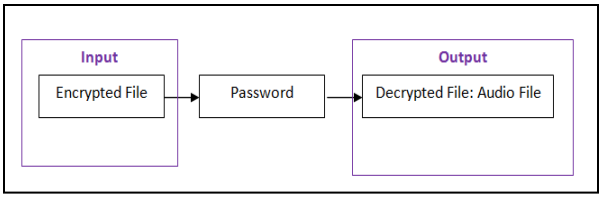


Figure 11. System Diagram to retrieve a hidden video file

*D. **Experimental Results 4:***

Applying, Steganography on an image for securing a Video file.

Figure 12. Resultant image where there is a hidden video file

IV. COMPARATIVE ANALYSIS

A comparison between the original and stego image was made, details were checked by analyzing the graphs and values of both images under gray level and colored level. It has been noticed that the histogram (size, number of pixels, median, and standard deviation) remained same in both images; only a very minor change was noticed in the fraction part of standard deviation which can be ignored.

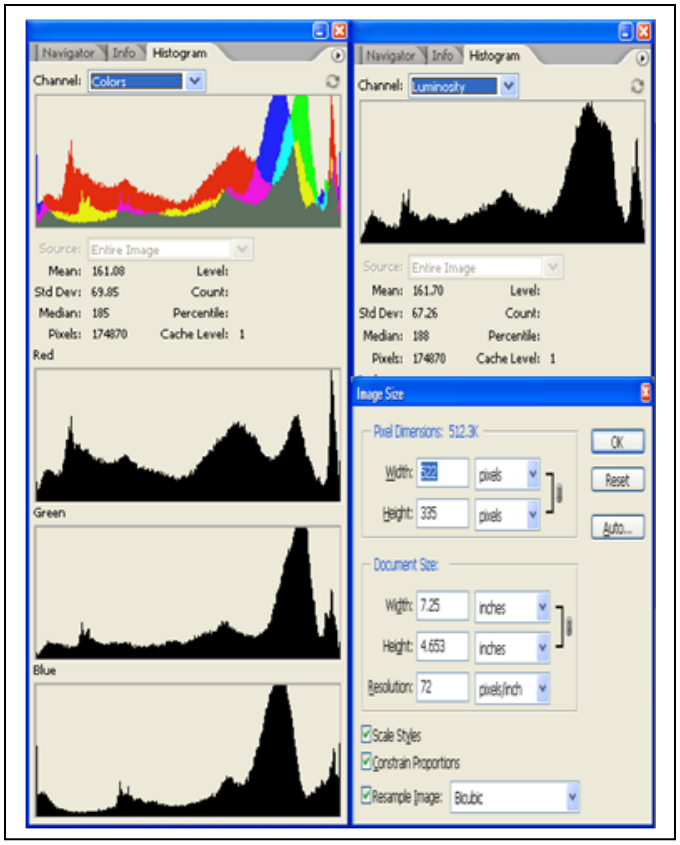


Figure 13. Histogram of Original Images(Fig. 3,4,5,7)

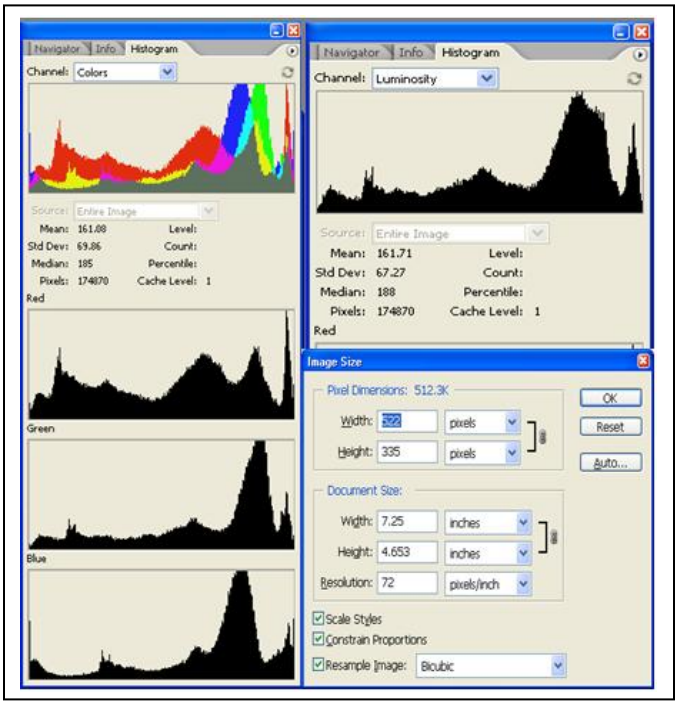


Figure 14. Histogram of Stegoed Images

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

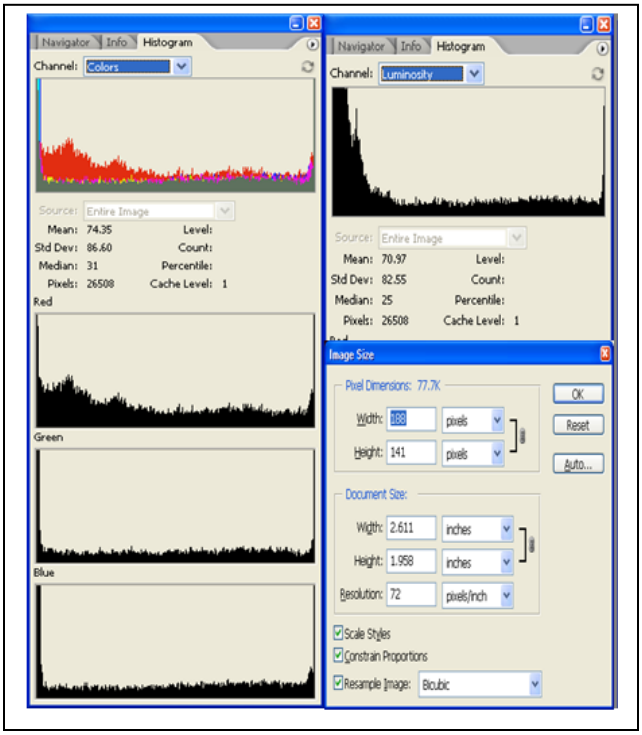


Figure 15. Histogram of Fig. 10

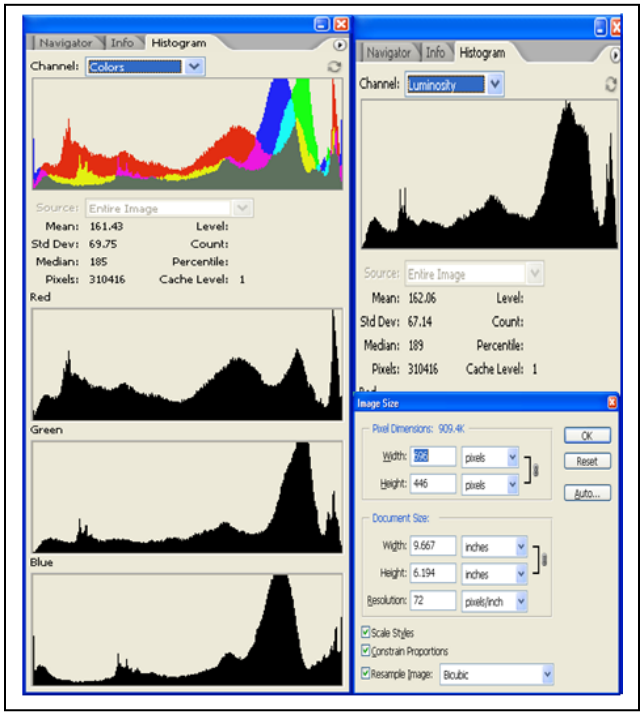


Figure 17. Histogram of Fig. 12

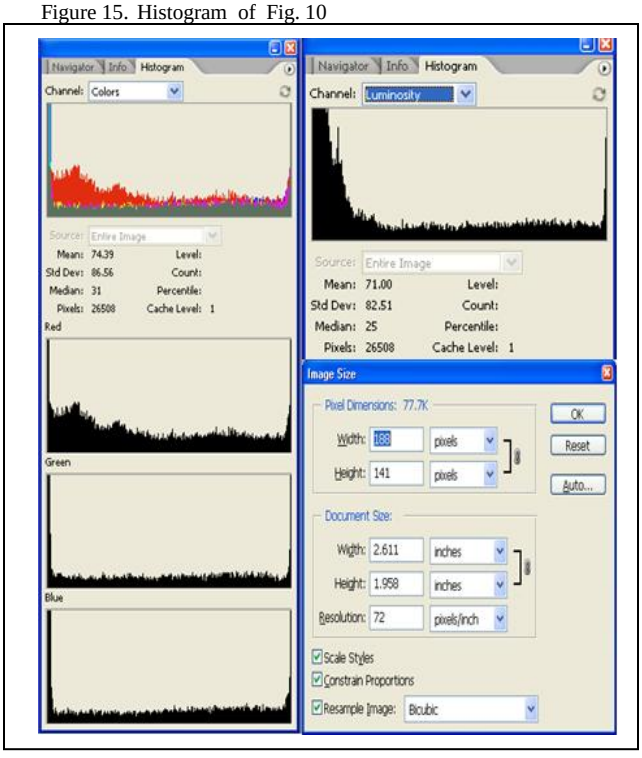


Figure 16. Histogram of Results of audio stegoed file

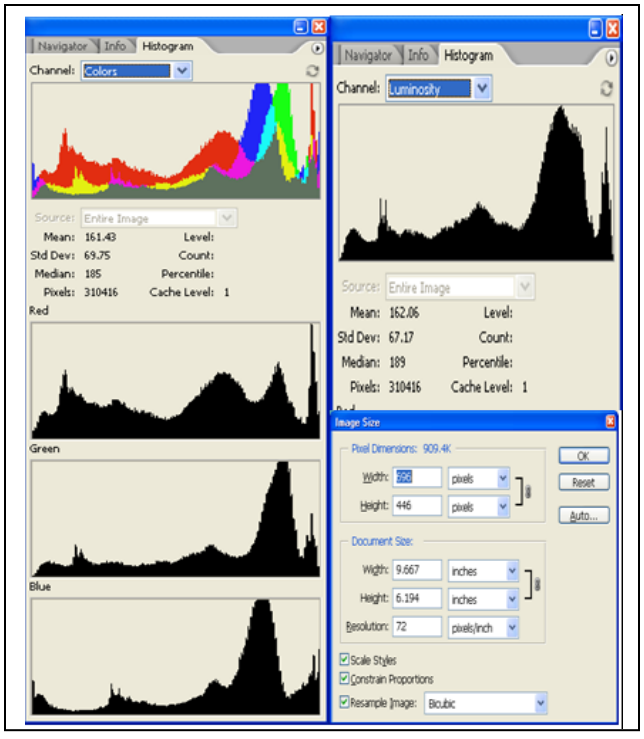


Figure 18. Histogram of Results of video stegoed file

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

V. CONCLUSION

Steganography is one of the most known methods of hiding data. This technology is easy to use but difficult to detect and this is one of the reasons to use it. The more you use this technology the more you know about it and get used to it. There are many other reasons to use it, like using it as cover medium key processes instead of using passwords to protect you data.

In this research Steganography and Steganalysis have been and studied and security parameters have been analyzed using a tool xiao tool which has different built in Cryptographic functions for adding security to the system. Different types of data types have been experimented to achieve both Steganography and Steganalysis. The tool was selected based on the reason that it supports both Steganography and Steganalysis in one. Later the results and the resultant images were taken in to Photoshop to see the graphical and detailed view of original and stegoed images. Different histograms views were made for the images containing different types of data. Histograms were noticed based on (size, number of pixels, median, and standard deviation) and a very minute different between the original image and the stegoed images was observed.

REFERENCES

[1] [1]. G. Eason, B. Noble, and I. N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955

[2] J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, pp.68–73, 1892

[3] I. S. Jacobs and C. P. Bean, "Fine particles, thin films and exchang anisotropy," in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, pp. 271–350, 1963

[4] Mohammad Shirali-Shahreza, "Text Steganography by Changing Words Spelling", Feb. 17-20, 2008 ICACT 2008

[5] R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press

[6] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982

[7] M. Young, The Technical Writer's Handbook. Mill Valley, CA University Science, 1989

AUTHORS PROFILE

Nighat Mir is a Computer Scince Lecturer in College of Engineering, Effat University, Jeddah, Saudi Arabia

She is also Pursuing her PhD studies from Bryson University, USA. Her subject of specialization is in Information Security using Text Watermarking and Text Steganography

Asrar Qadi is a Computer Science Graduate of Effat University for Fall 2010 session

Wissal Dandachi is a Computer Science Graduate of Effat Univeristy for Fall 2010 session

An Overview and Study of Security Issues & Challenges in Mobile Ad-hoc Networks (MANET)

Umesh Kumar Singh
Institute of Computer Science,
Vikram University Ujjain
INDIA-456010
umeshsingh@rediffmail.com

Shivlal Mewada
Institute of Computer Science,
Vikram University
Ujjain INDIA-456010
shiv.mewada@gmail.com

Lokesh laddhani
Institute of Computer Science,
Vikram University Ujjain
INDIA-456010
lokesh.laddhani@gmail.com

Kamal Bunkar
Institute of Computer Science,
Vikram University
Ujjain INDIA-456010
kamal.bunkar@gmail.com

***Abstract*- Mobile ad-hoc network (MANET) is one of the most promising fields for research and development of wireless network. As the popularity of mobile device and wireless networks significantly increased over the past years, wireless ad-hoc networks has now become one of the most vibrant and active field of communication and networks. Due to severe challenges, the special features of MANET bring this technology great opportunistic together. This paper describes the fundamental problems of ad hoc network by giving its related research background including the concept, features, status, and vulnerabilities of MANET. This paper presents an overview and the study of the routing protocols. Also include the several challenging issues, emerging application and the future trends of MANET.**

Keywords:- MANET, Wireless Networks, Ad-hoc Network, Routing Protocol

I. INTRODUCTION

Mobile Ad Hoc Networks (MANETs) has become one of the most prevalent areas of research in the recent years because of the challenges it pose to the related protocols. MANET is the new emerging technology which enables users to communicate without any physical infrastructure regardless of their geographical location, that's why it is sometimes referred to as an infrastructure less network. The proliferation of cheaper, small and more powerful devices make MANET a fastest growing network. An ad-hoc network is self-organizing and adaptive. Device in mobile ad hoc network should be able to detect the presence of other devices and perform necessary set up to facilitate communication and sharing of data and service. Ad hoc networking allows the devices to maintain connections to the network as well as easily adding and removing devices to and from the network. Due to nodal mobility, the network topology may change rapidly and unpredictably over time. The network is decentralized, where network organization and message delivery must be executed by the nodes themselves. Message routing is a problem in a decentralize environment where the topology fluctuates. While the shortest path from a source to a destination based on a given cost function in a static network is usually the optimal route, this concept is difficult to extend in MANET. The set of applications for MANETs is diverse, ranging from large-scale, mobile, highly dynamic networks, to small, static networks that are constrained by power sources. Besides the legacy applications that move from traditional infrastructure environment into the ad hoc context, a great deal of new services can and will be generated for the new environment. MANET is more vulnerable than wired network due to mobile nodes, threats from compromised nodes inside the network, limited physical security, dynamic topology, scalability and lack of centralized management. Because of these vulnerabilities, MANET is more prone to malicious attacks.

II. MANET VULNERABILITIES

Vulnerability is a weakness in security system. A particular system may be vulnerable to unauthorized data manipulation because the system does not verify a user's identity before allowing data access. MANET is more vulnerable than wired network. Some of the vulnerabilities are as follows:-

A. *Lack of centralized management:* MANET doesn't have a centralized monitor server. The absence of management makes the detection of attacks difficult because it is not east to monitor the traffic in a highly dynamic and large scale ad-hoc network. Lack of centralized management will impede trust management for nodes.

B. *Resource availability:* Resource availability is a major issue in MANET. Providing secure communication in such changing environment as well as protection against specific threats and attacks, leads to development of various security schemes and architectures. Collaborative ad-hoc environments also

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

allow implementation of self-organized security mechanism.

C. *Scalability:* Due to mobility of nodes, scale of ad-hoc network changing all the time. So scalability is a major issue concerning security. Security mechanism should be capable of handling a large network as well as small ones.

D. *Cooperativeness:* Routing algorithm for MANETs usually assumes that nodes are cooperative and non-malicious. As a result a malicious attacker can easily become an important routing agent and disrupt network operation by disobeying the protocol specifications.

E. *Dynamic topology:* Dynamic topology and changeable nodes membership may disturb the trust relationship among nodes. The trust may also be disturbed if some nodes are detected as compromised. This dynamic behavior could be better protected with distributed and adaptive security mechanisms.

F. *Limited power supply:* The nodes in mobile ad-hoc network need to consider restricted power supply, which will cause several problems. A node in mobile ad-hoc network may behave in a selfish manner when it is finding that there is only limited power supply.

G. *Bandwidth constraint:* Variable low capacity links exists as compared to wireless network which are more susceptible to external noise, interference and signal attenuation effects.

H. *Adversary inside the Network:* The mobile nodes within the MANET can freely join and leave the network. The nodes within network may also behave maliciously. This is hard to detect that the behavior of the node is malicious. Thus this attack is more dangerous than the external attack. These nodes are called compromised nodes.

I. *No predefined Boundary:* In mobile ad- hoc networks we cannot precisely define a physical boundary of the network. The nodes work in a nomadic environment where they are allowed to join and leave the wireless network. As soon as an adversary comes in the radio range of a node it will be able to communicate with that node. The attacks include Eavesdropping impersonation; tempering, replay and Denial of Service attack [1].

III. SECURITY IDEA

Security involves a set of investments that are adequately funded. In MANET, all networking functions such as routing and packet forwarding, are performed by nodes themselves in a self-organizing manner. For these reasons, securing a mobile ad -hoc network is very challenging. The goals to evaluate if mobile ad-hoc network is secure or not are as follows:

A. *Availability:* Availability means the assets are accessible to authorized parties at appropriate times. Availability applies both to data and to services. It ensures the survivability of network service despite denial of service attack.

B. *Confidentiality:* Confidentiality ensures that computer-related assets are accessed only by authorized parties. That is, only those who should have access to something will actually get that access. To maintain confidentiality of some confidential information, we need to keep them secret from all entities that do not have privilege to access them. Confidentiality is sometimes called secrecy or privacy.

C. *Integrity:* Integrity means that assets can be modified only by authorized parties or only in authorized way. Modification includes writing, changing status, deleting and creating. Integrity assures that a message being transferred is never corrupted.

D. *Authentication:* Authentication enables a node to ensure the identity of peer node it is communicating with. Authentication is essentially assurance that participants in communication are authenticated and not impersonators. Authenticity is ensured because only the legitimate sender can produce a message that will decrypt properly with the shared key.

E. *Non repudiation:* Non repudiation ensures that sender and receiver of a message cannot disavow that they have ever sent or received such a message .This is helpful when we need to discriminate if a node with some undesired function is compromised or not.

F. *Anonymity:* Anonymity means all information that can be used to identify owner or current user of node should default be kept private and not be distributed by node itself or the system software.

G. *Authorization:* This property assigns different access rights to different types of users. For example a network management can be performed by network administrator only.

IV. BROADCASTING APPROACHES IN MANET

In MANET [2], a number of broadcasting approaches on the basis of cardinality of destination set:

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

- *Unicasting*- Sending a message from a source to a single destination.
- *Multicasting*- Sending a message from a source to a set of destinations.
- *Broadcasting*- Flooding of messages from a source to all other nodes in the specified network.
- *Geocasting*- Sending a message from a source to all nodes inside a geographical region.

V. ATTACKS IN MANET

Securing wireless ad-hoc networks is a highly challenging issue. Understanding possible form of attacks is always the first step towards developing good security solutions. Security of communication in MANET is important for secure transmission of information [3]. Absence of any central co-ordination mechanism and shared wireless medium makes MANET more vulnerable to digital/cyber attacks than wired network there are a number of attacks that affect MANET. These attacks can be classified into two types:

1. Exterior Attack: External attacks are carried out by nodes that do not belong to the network. It causes congestion sends false routing information or causes unavailability of services.

2. Interior Attack: Internal attacks are from compromised nodes that are part of the network. In an internal attack the malicious node from the network gains unauthorized access and impersonates as a genuine node. It can analyze traffic between other nodes and may participate in other network activities.

A. *Denial of Service attack:* This attack aims to attack the availability of a node or the entire network. If the attack is successful the services will not be available. The attacker generally uses radio signal jamming and the battery exhaustion method.

B. *Impersonation:* If the authentication mechanism is not properly implemented a malicious node can act as a genuine node and monitor the network traffic. It can also send fake routing packets, and gain access to some confidential information.

C. *Eavesdropping:* This is a passive attack. The node simply observes the confidential information. This information can be later used by the malicious node. The secret information like location, public key, private key, password etc. can be fetched by eavesdropper.

D. *Routing Attacks:* The malicious node make routing services a target because it's an important service in MANETs. There are two flavors to this routing attack. One is attack on routing protocol and another is attack on packet forwarding or delivery mechanism. The first is aimed at blocking the propagation of routing information to a node. The latter is aimed at disturbing the packet delivery against a predefined path.

E. *Black hole Attack:* In this attack, an attacker advertises a zero metric for all destinations causing all nodes around it to route packets towards it. A malicious node sends fake routing information, claiming that it has an optimum route and causes other good nodes to route data packets through the malicious one. A malicious node drops all packets that it receives instead of normally forwarding those packets. An attacker listen the requests in a flooding based protocol.

F. *Wormhole Attack:* In a wormhole attack, an attacker receives packets at one point in the network, "tunnels" them to another point in the network, and then replays them into the network from that point. Routing can be disrupted when routing control message are tunneled. This tunnel between two colluding attacks is known as a wormhole.

G. *Replay Attack:* An attacker that performs a replay attack are retransmitted the valid data repeatedly to inject the network routing traffic that has been captured previously. This attack usually targets the freshness of routes, but can also be used to undermine poorly designed security solutions.

H. *Jamming:* In jamming, attacker initially keep monitoring wireless medium in order to determine frequency at which destination node is receiving signal from sender. It then transmit signal on that frequency so that error free receptor is hindered.

I. *Man- in- the- middle attack:* An attacker sites between the sender and receiver and sniffs any information being sent between two nodes. In some cases, attacker may impersonate the sender to communicate with receiver or impersonate the receiver to reply to the sender.

J. *Gray-hole attack:* This attack is also known as routing misbehaviour attack which leads to dropping of messages. Gray-hole attack has two phases. In the first phase the node advertise itself as having a valid route to destination while in second phase, nodes drops intercepted packets with a certain probability.

VI. MANET APPLICATIONS

With the increase of portable devices as well as progress in wireless communication, ad-hoc networking is gaining importance with the increasing number of widespread applications. Ad-hoc networking can be applied anywhere

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

where there is little or no communication infrastructure or the existing infrastructure is expensive or inconvenient to use. Ad hoc networking allows the devices to maintain connections to the network as well as easily adding and removing devices to and from the network. The set of applications for MANET is diverse, ranging from large-scale, mobile, highly dynamic networks, to small, static networks that are constrained by power sources. Besides the legacy applications that move from traditional infra structured environment into the ad hoc context, a great deal of new services can and will be generated for the new environment. Typical applications include [4].

A. *Military Battlefield:* Military equipment now routinely contains some sort of computer equipment. Ad- hoc networking would allow the military to take advantage of commonplace network technology to maintain an information network between the soldiers, vehicles, and military information headquarters. The basic techniques of ad hoc network came from this field.

B. *Commercial Sector:* Ad hoc can be used in emergency/rescue operations for disaster relief efforts, e.g. in fire, flood, or earthquake. Emergency rescue operations must take place where non-existing or damaged communications infrastructure and rapid deployment of a communication network is needed. Information is relayed from one rescue team member to another over a small hand held. Other commercial scenarios include e.g. ship-to-ship ad hoc mobile communication, law enforcement, etc.

C. *Local Level:* Ad hoc networks can autonomously link an instant and temporary multimedia network using notebook computers or palmtop computers to spread and share information among participants at e.g. conference or classroom. Another appropriate local level application might be in home networks where devices can communicate directly to exchange information. Similarly in other civilian environments like taxicab, sports stadium, boat and small aircraft, mobile ad hoc communications will have many applications.

D. *Personal Area Network (PAN):* Short-range MANET can simplify the intercommunication between various mobile devices (such as a PDA, a laptop, and a cellular phone). Tedious wired cables are replaced with wireless connections. Such an ad hoc network can also extend the access to the Internet or other networks by mechanisms e.g. Wireless LAN (WLAN), GPRS, and UMTS. The PAN is potentially a promising application field of MANET in the future pervasive computing context.

E. *MANET-VoVoN:* A MANET enabled version of JXTA peer-to-peer, modular, open platform is used to support user location and audio streaming over the JXTA virtual overlay network. Using MANET-JXTA, a client can search asynchronously for a user and a call setup until a path is available to reach the user. The application uses a private signaling protocol based on the exchange of XML messages over MANET-JXTA communication channels [5].

VII. MANET CHALLENGES

Regardless of the attractive applications, the features of MANET introduce several challenges that must be studied carefully before a wide commercial deployment can be expected. These include [4]:

A. *Routing in MANET:* Since the topology of the network is constantly changing, the issue of routing packets between any pair of nodes becomes a challenging task. Most protocols should be based on reactive routing instead of proactive. Multi cast routing is another challenge because the multi cast tree is no longer static due to the random movement of nodes within the network. Routes between nodes may potentially contain multiple hops, which is more complex than the single hop communication.

B. *Security and Reliability:* In addition to the common vulnerabilities of wireless connection, an ad hoc network has its particular security problems due to e.g. nasty neighbor relaying packets. The feature of distributed operation requires different schemes of authentication and key management. Further, wireless link characteristics introduce also reliability problems, because of the limited wireless transmission range, the broadcast nature of the wireless medium (e.g. hidden terminal problem), mobility-induced packet losses, and data transmission errors.

C. *Quality of Service (QoS):* Providing different quality of service levels in a constantly changing environment will be a challenge. The inherent stochastic feature of communications quality in a MANET makes it difficult *to* offer fixed guarantees on the services offered to a device. An adaptive QoS must be implemented over the traditional resource reservation to support the multimedia services.

D. *Inter-networking*: In addition to the communication within an ad hoc network, inter-networking between MANET and fixed networks (mainly IP based) is often expected in many cases. The coexistence of routing protocols in such a mobile device is a challenge for the harmonious mobility management.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

E. *Energy efficiency in MANET:* Power dissipation in a network protocol is an important issue that has not been given enough attention. Power technology is lagging behind micro-processor technology. Most mobile devices powered by mains are static. Mobile device (MDs) are mainly powered by batteries which do not last for a long time. MDs should give room for power conservation. MD transmits packets to the destination node via routing protocol. The intermediate nodes forward these packets to the destination node. The routing protocol of these intermediate nodes consumes some power from the battery in order to forward these packets to the destination node.

F. *Multicast:* Multicast is desirable to support multiparty wireless communications. Since the multicast tree is no longer static, the multicast routing protocol must be able to cope with mobility including multicast membership dynamics (leave and join).

G. *Location-aided Routing:* Location-aided routing uses positioning information to define associated regions so that the routing is spatially oriented and limited. This is analogous to associatively-oriented and restricted broadcast in ABR.

VIII. ROUTING PROTOCOLS

In MANET, routing protocol can be categorized in three category Proactive, Reactive and Hybrid protocol and they deal with limitations such as high power consumption, low bandwidth, high error rates and unpredictable movements of nodes.

A. *Proactive (Table-Driven):* The pro-active routing protocols [6, 7] are the same as current Internet routing protocols such as the Routing Information Protocol, Distance-Vector, Open Shortest Path First and link-state. They attempt to maintain consistent, up-to-date routing information of the whole network. Each node has to maintain one or more tables to store routing information, and response to changes in network topology by broadcasting and propagating. Some of the existing pro-active ad hoc routing protocols are: Destination Sequenced Distance-Vector, Wireless Routing Protocol, Cluster head Gateway Switch Routing, Global State Routing, Fisheye State Routing, Hierarchical State Routing, Zone based Hierarchical Link State, Source Tree Adaptive Routing .

B. *Reactive (Source-Initiated On-Demand Driven):* These protocols try to eliminate the conventional routing tables and consequently reduce the need for updating these tables to track changes in the network topology. When a source requires to a destination, it has to establish a route by route discovery procedure, maintain it by some form of route maintenance procedure until either the route is no longer desired or it becomes inaccessible, and finally tear down it by route deletion procedure. In pro-active routing protocols, routes are always available (regardless of need), with the consumption of signaling traffic and power. On the other hand, being more efficient at signaling and power consumption, re-active protocols suffer longer delay while route discovery. Both categories of routing protocols have been improving g to be more scalable, secure, and to support higher quality of service.

C. *Hybrid Protocols:* Hybrid routing protocols [6] aggregates a set of nodes into zones in the network topology. Then, the network is partitioned into zones and proactive approach is used within each zone to maintain routing information. To route packets between different zones, the reactive approach is used. Consequently, in hybrid schemes, a route to a destination that is in the same zone is established without delay, while a route discovery and a route maintenance procedure is required for destinations that are in other zones. The zone routing protocol (ZRP) and zone-based hierarchical link state (ZHLS) routing protocol provide a compromise on scalability issue in relation to the frequency of end-to-end connection, the total number of nodes, and the frequency of topology change. Furthermore, these protocols can provide a better trade-off between communication overhead and delay, but this trade-off is subjected to the size of a zone and the dynamics of a zone. Thus, the hybrid approach is an appropriate candidate for routing in a large network. At network layer, routing protocols are used to find route for transmission of packets. The merit of a routing protocol can be analyzed through metrics-both qualitative and quantitative with which to measure its suitability and performance. These metrics should be independent of any given routing protocol. Desirable qualitative properties of MANET are Distributed operation, Loop-freedom, Demand-based operation, Proactive operation, Security, Sleep period operation and unidirectional link support. Some quantitative metrics that can be used to assess the performance of any routing protocol are End-to-end delay, throughput, Route Acquisition Time, Percentage Out-of-Order Delivery and Efficiency. Essential parameters that should be varied include: Network size, Network connectivity, Topological rate of change, Link capacity, Fraction of unidirectional links, Traffic patterns, Mobility, Fraction and frequency of sleeping nodes [2, 7].

IX. CONCLUSION

In this paper, we have analyzed the MANET vulnerabilities, security threats an ad-hoc network faces and presented the security objective that need to be achieved. On one hand,

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

the security-sensitive applications of an ad-hoc networks require high degree of security on the other hand, ad-hoc network are inherently vulnerable to security attacks. Therefore, there is a need to make them more secure and robust to adapt to the demanding requirements of these networks. The future of ad- hoc networks is really appealing, giving the vision of cheap communications. At present, the general trend in MANET is toward mesh architecture and large scale. Improvement in bandwidth and capacity is required, which implies the need for a higher frequency and better spatial spectral reuse. Propagation, spectral reuse, and energy issues support a shift away from a single long wireless link (as in cellular) to a mesh of short links (as in ad- hoc networks). Large scale ad hoc networks are another challenging issue in the near future which can be already foreseen. As the involvement goes on, especially the need of dense deployment such as battlefield and sensor networks, the nodes in ad-hoc networks will be smaller, cheaper, more capable, and come in all forms. In all, although the widespread deployment of ad-hoc networks is still year away, the research in this field will continue being very active and imaginative.

REFERENCES

[1]. A Mishra and K.M Nadkarni," Security in wireless Adhoc network, in Book. The Hand book of Ad-Hoc Wireless Networks", CRC press LLC, 2003.
[2]. IIyas, M., 2003.The hand book of ad -hoc wireless networks. CRC press LLC.
[3]. P. Papadimitrates and Z.J. Hass," secure Routing for mobile Ad Hoc Networks", in proc. of SCS Comm. Networks and Distributed system modelling and simulation Conference , San Antonio, TX, Jan. 2002.
[4]. HaoYang, Haiyun & Fan Ye," Security in mobile ad-hoc networks: Challenges and solutions", Vol 11, issue 1, 2004.
[5]. Luis Bernardo et al., "A Telephony Application for Manets: Voice over a MANET-Extended JXTA Virtual Overlay Network".
[6]. Belding-Royer, E.M. and C.K. Toh, 1999. A review of current routing protocols for ad-hoc mobile wireless networks.IEEE Personal Comm. magazine pp:46-55.
[7]. Broch,J., A.M David and B. David, "A Performance comparison of multi-hop wireless ad hoc network routing protocols. Proc. IEEE/ACM MOBICOM' 1998.

AUTHORS PROFILE

Biographical notes

Dr. Umesh Kumar Singh obtained his Ph.D. in Computer Science from Devi Ahilya University, Indore-INDIA. He is currently Reader (Director) in Institute of Computer Science, Vikram University, Ujjain-INDIA. He served as professor in Computer Science and Principal in Mahakal Institute of Computer Sciences (MICS-MIT), Ujjain. He is formally Director I/c of Institute of Computer Science, Vikram University Ujjain. He has served as Engineer (E&T) in education and training division of CMC Ltd., New Delhi in initial years of his career. He has authored a book on "Internet and Web technology "and his various research papers are published in national and international journals of repute. Dr. Singh is reviewer of International Journal of Network Security (IJNS), ECKM Conferences and various Journals of Computer Science. His research interest includes network security, secure electronic commerce, client-server computing and IT based education.

Shivlal Mewada holds a M.Sc. in Computer Science from Institute of Computer Science, Vikram University, Ujjain-INDIA. He is currently pursuing M.Phil. (Master of Philosophy) in Computer Science from Institute of Computer Science, Vikram University, Ujjain- INDIA. His research interest includes Network Security, Ad-hoc Networks, Wireless Mesh Network Security and IT based education.

Lokesh Laddhani holds a MCA from Institute of Computer Science, Vikram University, Ujjain-INDIA. He is currently pursuing Ph.D. in Computer Science from Institute of Computer Science, Vikram University, Ujjain-INDIA. He is working as Guest Lecturer in Institute of Computer Science, Vikram University, Ujjain - INDIA. His research interest includes Wireless Mesh Network.

Kamal Bunkar M.Tech(I.T.) from SOIT, R.G.P.V. Bhopal, B.E (C.S.) from Govt. Engineering Collage Ujjain. He is working as a Lecturer in Institute of Computer Science, Vikram University, Ujjain-INDIA. His research interest include Networking and Data mining .

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

An Intelligent Agent Based Text-Mining System: Presenting Concept through Design Approach

[1]Kaustubh S. Raval
M.Tech. (Computer Engineering)
raval_kaustubh@yahoo.co.in

[2]Ranjeetsingh S. Suryawanshi
M.Tech. (Computer Engineering)
ranjeetsuryawanshi06@gmail.com

[3]Professor Devendra M. Thakore
Department of Computer Engineering
dmthakore@bvucoep.edu.in

[1, 2, 3] Bharati Vidyapeeth Deemed University,
College of Engineering, Pune – 411043.

***Abstract* – Text mining is a variation on a field called data mining and refers to the process of deriving high-quality information from unstructured text. In text-mining the goal is to discover unknown information, something that may not be known by people. Now here the aim is to design an intelligent agent based text-mining system which reads on the text (input) and based on the keyword provide the matching documents (in the form of links) or options (statements) according to the user's query. In this paper the effort is to depict design approach for intelligent agent based text mining system.**

Keywords – Data Mining, Text Mining, Intelligent agent.

I. INTRODUCTION

First of all, we need basic information about various terms on which this work is to be carried out.

Data Mining: Data mining is the analysis of (often large) observational data sets to find unsuspected relationships and to summarize the data in novel ways that are both understandable and useful to the data owner. It derives business intelligence from the data warehouse by using advanced analytical techniques such as neural network heuristics, fuzzy logic, statistical analysis etc.

Automated Data Mining: Using automated data mining we can sweep through databases and discover previously unknown patterns. In their paper [1], Dr. V. Saravanan and J. Rajan proposed an automated data mining system which compasses familiar data mining algorithms. According to them the system will automatically select the appropriate data mining technique and select the necessary field needed from the database at the appropriate time without expecting the users to specify the specific techniques and the parameters.

Text Mining: Text-mining is a variation on a field called data-mining and refers to the process of deriving high-quality information from the unstructured text. 'High quality' in text-mining

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

usually refers to some combination of relevance, novelty and interestingness. [3]

Intelligent Agents: Intelligent agents are software entities that carry out some set of operations on behalf of a user with some degree of independence or autonomy, and in doing so, employ some knowledge or representation of the user's goals or desires. Software agents are useful in automating repetitive tasks, finding and filtering information, intelligently summarizing complex data, and so on, but more importantly, just like their human counterparts, intelligent agents can have capability to learn from the managers and even make recommendations to them regarding a particular course of action. Agents have several common characteristics, such as their ability to communicate, cooperate, and coordinate with other agents in system. Each agent is capable of acting autonomously, cooperatively, and collectively to achieve the collective goal of a system. The coordination capability helps manage problem solving so that co-operating agents work together as a single team. [9]

Motivation

The literature study of various research papers and my interest in the field of 'Data Mining' motivated me to take up this as my dissertation topic for post-graduation.

Study of existing biomedical text mining system, named, 'PolySearch' also provide the insights to overall 'text mining system' and thus lead me to take up 'Intelligent Software Agent Based Text Mining' as my dissertation topic.

Working scenario of 'Google Search Engine' also has been the motivational factor to take up this topic as my dissertation work. 'Google Search Engine' is the best example of optimized intelligent software agent based text-mining system encompassing a very large domain of web.

II. System Design

System design includes use-case diagram and sequence diagram. Use-case diagram depicts how the user interacts with the proposed intelligent agent based system whereas the sequence diagram depicts how the flow of actions carried out by different agents in the system.

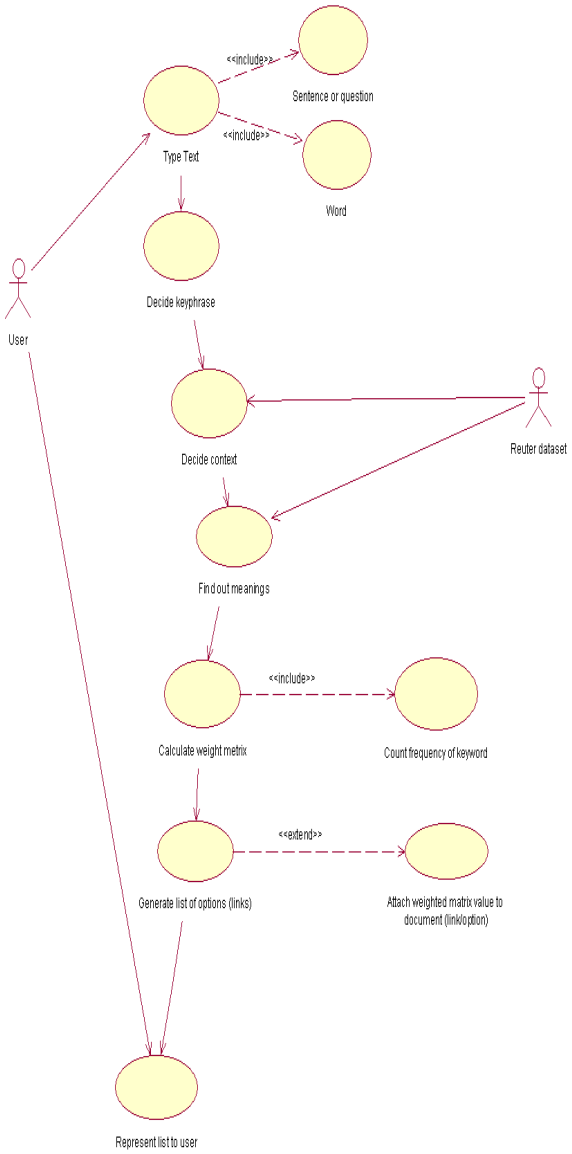


Fig. 1 User Interacting with system

As shown in the Fig. 1 user will type the text then text miner agent 1, which is keyphrase-based,

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

will decide the keyword then intelligent agent will decide the context for that 'keyword' then text miner agent 2, which is keyword based, will decide the meaning of the keyword in particular context, find out related documents, calculate weight matrix value and then attach that value to the document. Then intelligent agent will rank the documents based on weight-matrix values.

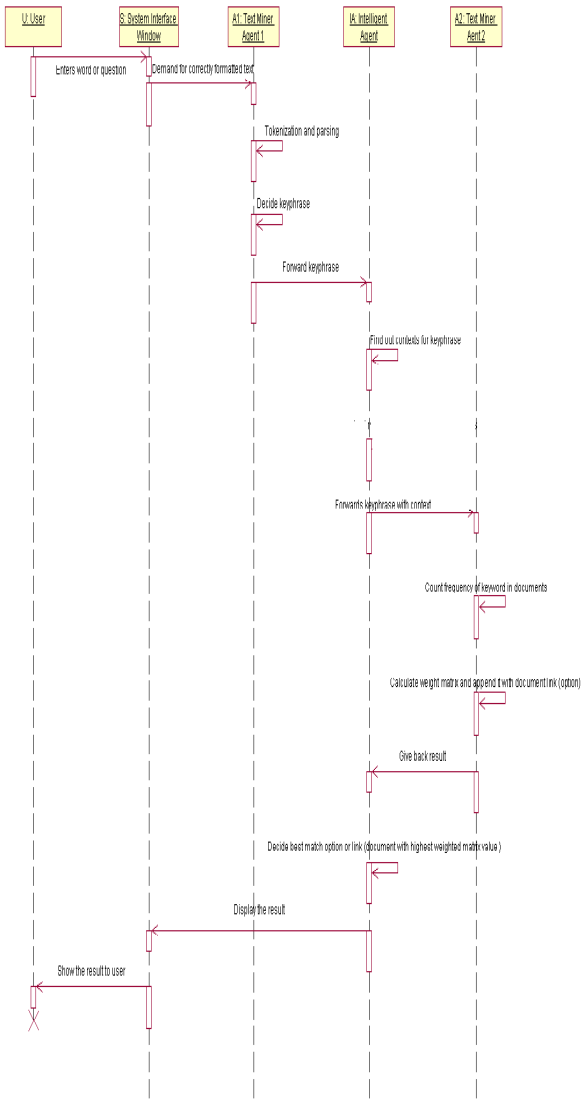


Fig. 2 Sequence Diagram

Fig. 2 shows the sequence diagram of the system interaction diagram between different agents of the system.

III. System Description

System description is the context which includes the details about the overall working of the existing or proposed system.

Why Agents?

Text mining mainly includes the field of information retrieval which means the finding of documents which contain answers to questions and not the finding of answers itself and for this to achieve statistical measures and methods are used. By using statistical measures and methods automatic processing of text data and comparison to given question is performed. But the issue here is how to automate the processing of text data? And that is where 'Agents' come into picture.

System Architecture

Fig. 5 shows the architectural diagram for intelligent agent based text-mining system. It includes all the components required to make the system workable and the relationship and interaction between them. There are mainly three agents, one dataset, the user category, and one cache/log component.

Working of the Intelligent Agent in two phases::

Phase 1:

- Takes the input from Text Miner Agent 1 (that is key-phrase/keyword).
- Find out the contexts (documents) for key-phrase word.

Phase 2:

- Takes input from Text Miner Agent 2 that is links and their associated weight matrix values.
- Compare the weight matrix values of various links and decide which one is the 'close-to-best-match' for user's query.
- The link with the highest weight matrix value ranked first, the link with second highest weight matrix value ranked second, the link

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

with third highest weight matrix value ranked third and so on.

- Display the ranked links to the user.

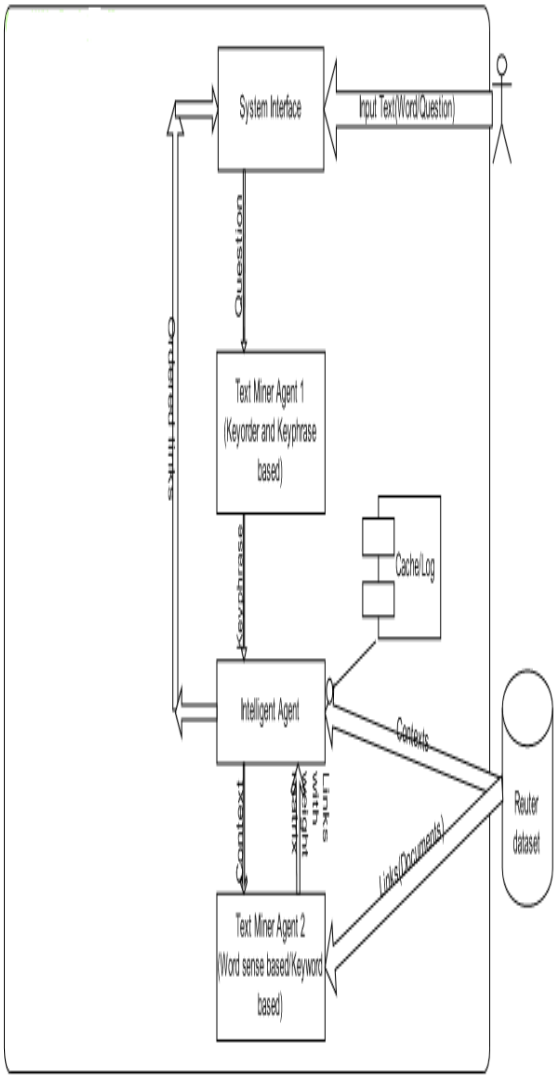


Fig. 3 Architecture of Intelligent Agent Based Text-Mining System

Phases in working of Intelligent Agent

In the proposed 'Intelligent agent based' system, the intelligent agent should have to work in two phases.

In phase 1, the intelligent agent would prompt the text miner agent 1, which is 'Key-order and Key-phrase based agent', for the required 'key-phrase' based on which various contents need to be determined. Fig. 4 shows the pictorial view of the working of the intelligent agent in phase 1 in terms of flowchart.

In phase 2, the intelligent agent takes the input from text miner agent 2, that is 'Keyword based agent'. The input contains the list of links (documents/options) with associated 'weight matrix value'. These links are retrieved by checking the every context, containing different documents, in which the 'key-phrase' or 'keyword' has appeared. Now, using 'Decision making algorithm' the intelligent agent decides which one of the many links (documents/options) is the 'close-to-exact-match' for the information user is looking forward.

The link (document/option) with associated highest 'weight matrix value' is decided to be the 'close-to-best-match' then the next link with second highest 'weight matrix value' is the second best match and so on. Then these links are ordered and ranked according to their 'weight matrix value' and presented to the user. Fig. 5 shows the pictorial view of the working of the intelligent agent in phase 1 in terms of flowchart.

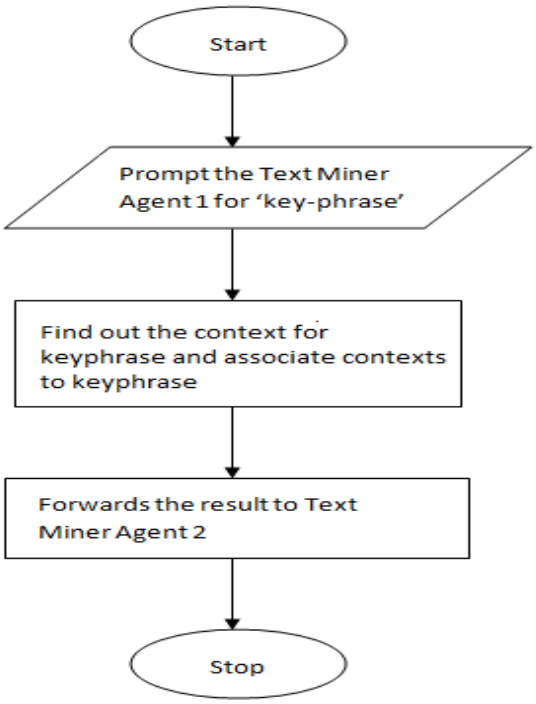


Fig. 4 Working of Intelligent agent in phase 1

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

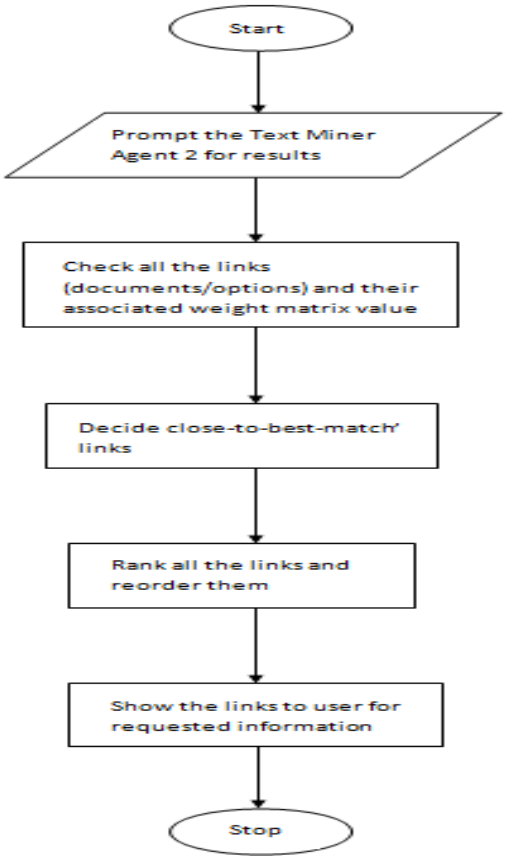


Fig. 5 Working of Intelligent Agent in phase 2

IV Applications

The proposed system would work as the base for some specific fields where there is a requirement of intelligent agent based text-mining.

Each of these fields has different requirements for the type of information according to various uses.

1) Medical Science

In medical science field, the new inventions of medicines and vaccines are increasing day by day. So, the doctors need to be aware of what is going on in their field? Moreover, doctors are concerned to cure patients properly using medicines and by other means.

Thus, the system which is to be developed under this dissertation work will provide the base for the specific 'Text-Mining System for Medical Science' and provide the automated way of dealing with details required for various diseases and their probable solutions.

2) Space Science

There are always new researches are going on in the field of space science and those are mainly related to astronomy.

Scientists are working to find out the cause of earth's birth, how the environment has been developed on earth? How these all planets were taken birth? How the perimeters have been decided for every planet? All these types of questions require mining of too much information and scientists have to look for each and every aspect of the information very carefully.

Thus, the system which is to be developed can work as the base for 'Text-Mining System for Space Science' and provide the useful information to scientists for their research work.

3) Engineering Technologies

Engineering is the field which encompasses various specific fields in it. All these fields have specific applications and this requires dealing with too much text content. Engineers in different fields need to be finding out solutions for various technological and technical problems. Now, dealing with huge amount of text data is not an easy task, so it's better to have an automated (intelligent agent based) system to perform all this work.

The intelligent agent based text mining system works with huge amount of data and retrieve required data in fraction of seconds or minutes (In an ideal condition). Thus the

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

intelligent agent based systems can speed up the data retrieval and processing.

Thus, the system which is to be developed can work as the base for 'Text-Mining System for Engineering Technologies' and provide the useful information to scientists/engineers for their research work.

CONCLUSION

Based on these design specifications, the intelligent agent based text-mining system would be developed in which intelligent agent need to incorporate two algorithms:

1) Decision making algorithm – to determine possible context (documents) for the keyword.
2) Ranking algorithm – to rank the documents (options).

REFERENCES

[1] Dr. V. Saravanan and J. Rajan, "A Framework of an Automated Data Mining System using Autonomous Intelligent Agents", International Conference on computer Science and Technology, pages 700-704, 2008.

[2] Ranjit Bose and Vijayan Sugumaran, "IDM: An Intelligent Software Based Data Mining Environment", IEEE, pages 288-2893, 1998.

[3] Vishal Gupta and Gurpreet S. Lehal, "A Survey of Text Mining Techniques and Applications", Journal of Emerging Technologies in Web Intelligence, vol. 1,pages 60-76, August 2009.

[4] Ah-Hwee Tan, "Text Mining: The state of the art and the challenges".

[5] J. You and J. Liu, "An Agent Based Visual Data Mining for Intelligent Web Browsing with E-Commerce Applications", IEEE International Fuzzy Systems Conference, pages 936-939, 2001.

[6] Azuraliza Abu Bakar, Zulaiha Ali Othman, Abdul Razak Hamdan, Rozianiwati Yusof, Ruhaizan Ismail, "Agent Based Data Classification Approach for Data Mining", IEEE, 2008.

[7] Dae Su Kim, Chang Suk Kim, and Kee Wook Rim, "Modelling and Design of Intelligent Agent System", International Journal of Control, Automation, and Systems Vol. 1, No. 2, pages 257-261, June 2003.

[8] Andreas Hotho, Andreas Nurnberger, and Gerhard Paaß, "A brief Survey of text mining".

[9] Stuart Russell and Peter Norvig, "Artificial In telligence, Chapter 2: Intelligent Agents – A Modern Approach".

AUTHORS PROFILE

1) Kaustubh S. Raval graduated (B.E - Computer Engineering) from Gujarat University, Ahmedabad, and State-Gujarat in the year 2009. Currently pursuing M.Tech. (Computer) with specialization in subject 'Data Mining' from Bharati Vidyapeeth Deemed University College of Engineering, Pune.
2) Ranjeetsingh S. Suryawanshi graduated (B.E – Computer Engineering) from Pune University, and State – Maharashtra in the year 2005. Currently pursuing M.Tech. (Computer) with specialization in subject 'Data Mining' from Bharati Vidyapeeth Deemed University College of Engineering, Pune.
3) Professor D.M.Thakore graduated (B.E – Computer Engineering) from Shivaji University, Sangali, and State – Maharashtra in 1990.

   He had pursued his M.E. (Computer) from Bharati Vidyapeeth University College of Engineering, Pune in 2004.

   He is currently pursuing his Ph.D. with specialization in subject 'Data Mining/Text Mining' from Bharati Vidyapeeth Deemed University College of Engineering, Pune.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

TEMPERATURE MEASUREMENT OF DYNAMIC OBJECT

Varsha Khare
Shivajirao S. Jondhle Polytechnic,
Asangaon Maharashtra India
geetaharshu@gmail.com

Mrs. Rodge M.P.
Shivajirao S. Jondhle College of Engg & Tech.
Asangaon, Maharashtra India
vjtsscoe@rediffmail.com

Abstract:

Temperature is one of the most commonly measured and controlled parameters in industry. Proper monitoring and control of process temperature improves product quality, reduces product scrap, and improves overall product yield and process speed. Every industry in today's competitive marketplace is putting in place programs and systems to lower production costs, through automated production and quality control systems. To measure temperature of dynamic object most of the industries are using telemetry technique for temperature measurement. This technique has certain limitations like; limited range of temperature, surface of dynamic objects, battery life and safety factor. In this paper an attempt is made to overcome this limitations using infrared thermometry. This system is tested on Zamak Mould Machine & Volkswagen Welding Machine in Tata Ficosa Company, Pune. It is nondestructive measurement method so no damage to product and no breakage due to contact with moving objects.

Keywords: ***Infrared Sensor, Microcontroller, Zamak Mould Machine & Volkswagen Welding Machine***

I. INTRODUCTION

In industry there are many cases when we want to measure the various parameters of dynamic objects like temperature, vibration etc.; it is the need in industry as it affects life, reliability of machine. Many a time's safety factor is also involved. Temperature measurement is required for many applications such as engine shaft, machine shafts, pumps, generator etc. It improves product quality, reduces product scrap, and improves overall product yield and process speed.

Most of the industries are using telemetry technique for temperature measurement. In this technique miniature battery with sensor and RF transmitter is situated on dynamic object & it transmits temperature data to stationary receiver located nearby where it is measured & indicated. This has certain limitations given as below.

- Surface of dynamic object may not be suitable. For example oil leakage on the surface i.e. high cleaning and maintenance required.
- Range of temperature.
- Battery life.

An attempt is made to overcome these difficulties by using infrared temperature system. This technique has no battery, no contact to surface of the dynamic object. Non-contact infrared temperature systems provide accurate reliable and cost effective temperature measurements at process critical control points. This technique comes under wireless infrared telemetry.

This measuring technique uses the properties of infra-red (IR) light waves to determine a target's temperature. By employing an infrared detector, the sensor detects the amount of thermal energy emitted from a target as IR light. There is known relationship between the amount of infrared relation emitted by an object and the object surface temperature.

II. EXPLANATION:

The Block diagram of the system is given in fig.-1. Dynamic object may be linear or rotary moving object, such as products on conveyor belts of which

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

temperature is to be measured. Infrared sensor senses the rays transmitted by dynamic object and generates equivalent analog output. This sensor detects only specific IR wavelength. So, other sources of IR light, such as, the sun, will not interfere with the measurement. It calibrates the IR t/c (thermo couple) to provide a linear output signal similar to a specific thermocouple type over a specified temperature range. Thermopile sensor with lense system provides filtering and focusing and gives variable output in mV. Buffer is used for isolation and to avoid loading to the sensor. Power supply provides the necessary voltage to all circuits. Buzzer is provided to indicate the limit i.e. alarm signal when a temperature reaches a critical high or low point.

Gain amplifier changes the output in the range of 0 to 5 volts with the resolution of 0.019 volt and adjusts gain to match ADC input to 89c51 microcontroller. The 89c51 is a low power, high performance CMOS 8 bit microcomputer with 4KB bytes of flash programmable and erasable read only memory (PEROM). The Flash memory allows the program to be reprogrammed in-system or by a nonvolatile memory programmer. By combining a versatile 8 bit CPU with on a monolithic chip, the Atmel AT89c51 is a powerful microcomputer which provides a highly flexible and cost effective solution to many embedded control applications. So it is used worldwide. Microcontroller output to LCD ASCII data for display and to RS232 converter to PC.

The major features of IR t/c temperature sensors:

- Highly repeatable
- Non-contact measurement method
- Self-powered no excitation needed
- Emulates a t/c within a specific temperature range with 2%
- Smart IRt/c's linearize over wide temperature ranges with superb accuracy.
- Multiple output options available
- Factory calibrated to real world operation conditions
- Small size, simple, rugged and intrinsically safe
- Easy installation - Fast response time
- Interchangeability ±1% cost effective

Advantages:

- Nondestructive method so no damage to the product.
- less cleaning and maintenance required due to non-contact method
- No breakage due to contact with moving object
- Fast thermal response time.
- Wide temperature range
- Highly accurate data by measuring actual product temperature, not the sensor's Temperature

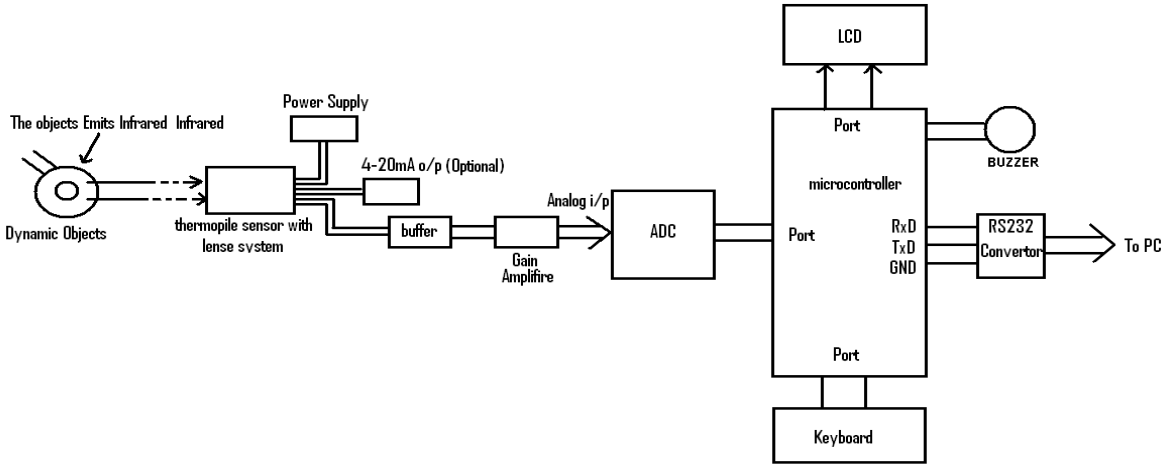


Fig. 1: Block Diagram of Temperature Measurement of Dynamic object.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

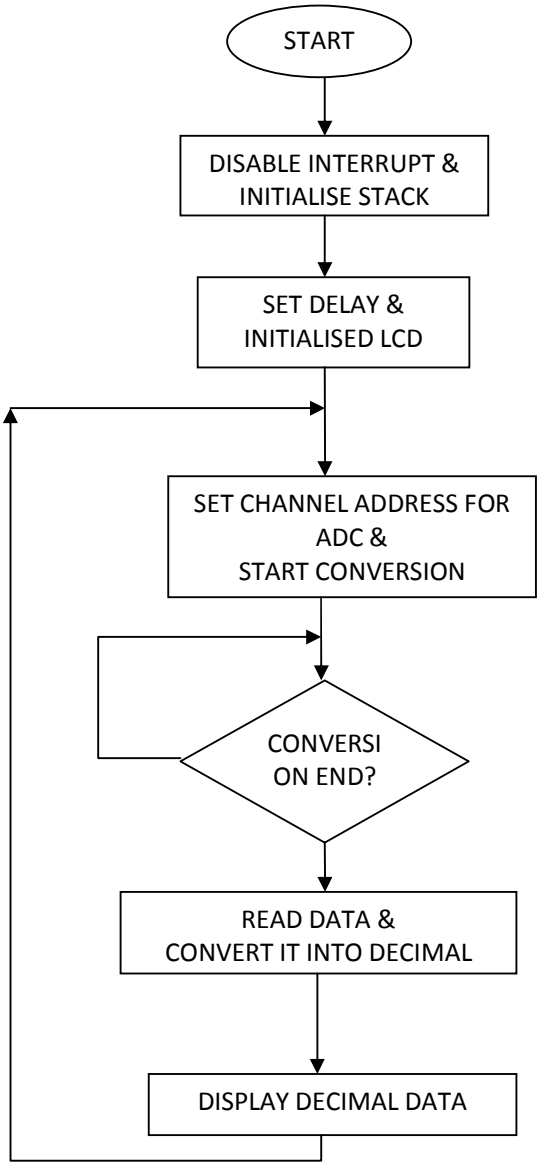


Fig. 2 FLOW CHART

EXPERIMENTATION

Flow chart is given in fig. 2.

Case - 1

The system is tested the temperature on Zamak Mould Machine in Tata Ficosa Company, Pune whose basic set up is shown in above fig.3. The pump motor which is circulating water should not burn due to dry run or heat transfer by liquid. Temperature of pump should not increase otherwise it will burn itself.

Our sensor senses the shaft temperature directly. Sensor reading is noted as indicated temperature and it is seen that present readings are on +2□ more range than the actual one which is acceptable as it is below 5% of span which is required for present application. Graph 1 shows better accuracy between actual and measured temperature which is given in table 1.

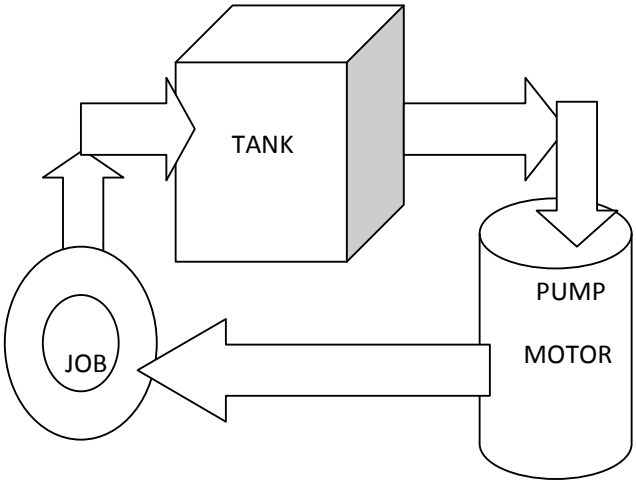
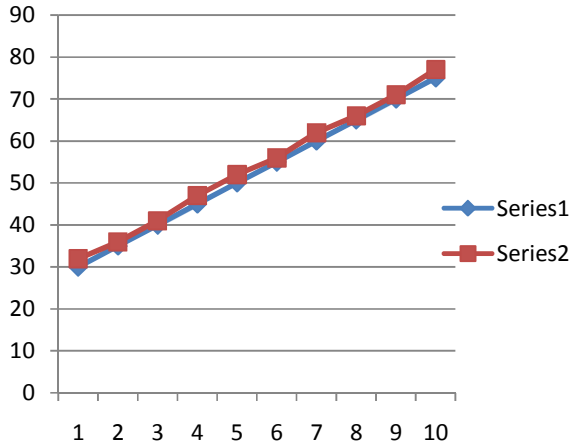


Fig. 3 Schematic Setup For Colling Zamak Mould Machine

Actual Temp	Measured Temp
30	32
35	36
40	41
45	47
50	52
55	56
60	62
65	66
70	71
75	77

Table 1

http://sites.google.com/site/ijcsis/
ISSN 1947-5500



Graph 1

Case - 2.

The same system is tested temperature on Volkswagen welding machine in Tata Ficosa Company, Pune. The plastic part welding (fig.4) is done by using heaters where it is not possible to attach normal sensor on the heater surface which is used for welding is having movable part (Axial) along with it. Also wiring is problem for attachment of sensor on such type of surface. The time duration for welding is 30 seconds. If temperature is higher than plastic will burn out, if it is lower than plastic will not get welded & there will be leakage and it may also damaged circuit. Sensor shows readings on higher value by 3 degree than actual one. Due to correct temperature & focusing of sensor wastage of material is reduced. Graph 2 shows better accuracy between actual and measured temperature which is given in table 2.

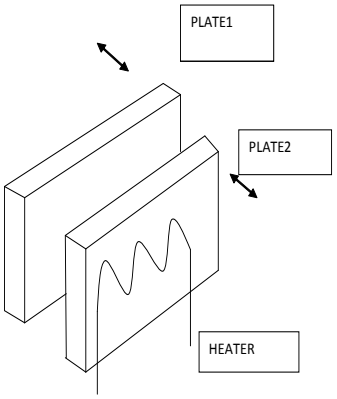
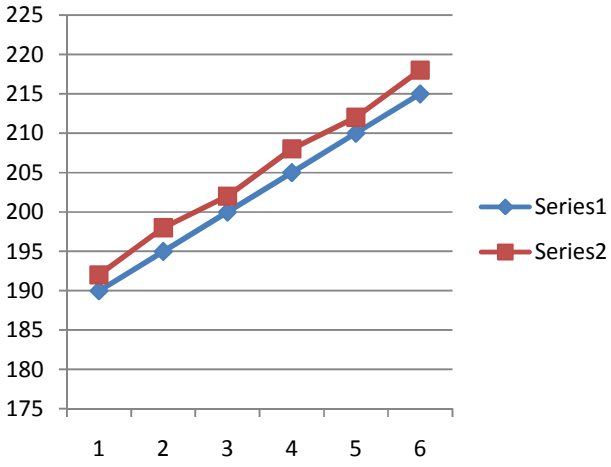


Fig. 4. PLASTIC WELDING MACHINE

Actual Temp	Measured Temp
190	192
195	198
200	202
205	208
210	212
215	218

Table 2



Graph 2

RESULT & CONCLUSION

The system has been tested the temperature on different machines which were operating at very high temperatures ranges from 200 to 550. We have observed in all cases that the temperature variation ranges from 2 to 6 degree.

Infra-red temperature technology improves the process control and throughput also increases production speed and reduces scrap through regulation of process critical procedures. It improves quality with a low cost, direct monitoring solution, decrease safety risks due to out of control processes. This technique can be used to measure the temperature of moving or dirty samples,

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

too difficult or labor intensive for a contact measurement technique.

The same system can work for higher temperature upto 1000 degree range by lineraising the sensor input using lookup table. The system can be connected to P.C for continuous monitoring by providing serial communication.

REFERENCES

[1]. "The 8051 micro controller and embedded system", Muhammad Ali Mazidi
[2]. Vanice Gillispi Mazdi, Persow Prentice Hall.
[3]. Atmel data book for microcontroller
[4]. National semiconductor manual analog electronics
[5]. Infrared thermometry Dwyer USA
[6]. IR manual Exergen UK
[7]. www.atmel.com
[8]. www.microcontroller.com

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Dynamic Slicing of Aspect-Oriented Programs using AODG

Sk Riazur Raheman
Dept of MCA
REC, Bhubaneswar
Orissa, India
skriazur79@gmail.com

Abhishek Ray
School of Technology
KIIT University
Orissa, India
armmclub@gmail.com

Sasmita Pradhan
Dept of MCA
REC, Bhubaneswar
Orissa India
jusasmita@gmail.com

***Abstract* - In software engineering, the programming paradigms of Aspect-Oriented Programming (AOP) attempt to aid programmers in the separation of concerns, specifically cross-cutting concerns. All programming methodologies including procedural programming and object-oriented programming support some separation and encapsulation of concerns into single entities. Since such crosscutting aspects are usually distributed among objects in object-oriented programming, it is difficult to maintain them consistently. In AOP they can be written in a single aspect and thus easy to maintain. This research work proposes an algorithm for calculating the Dynamic Slice of AOP, which uses Aspect Oriented Dependence Graph (AODG) and traversing algorithm.**

Keywords – AOP; Cross-cutting concern; AODG; Data dependence; Control dependence; Weaving arc; Call arc.

I. INTRODUCTION

Program slicing was first introduced by Weiser in 1979 [3], is a decomposition technique that extracts from program statements relevant to a particular computation [2]. A *program slice* consists of the parts of a program that affect the values computed at some point of interest. Such a point of interest is referred to as a *slicing criterion*, and is typically consists of a pair <S, V>, where S is a program statement and V is a subset of program variables [2]. There are two major kinds of approaches in program slicing. The first approach is Weiser's [3] original slicing approach in which slices are computed in an iterative process by computing consecutive sets of relevant variables for each node in the CFG. The second approach is slicing using graph reachability [1]. In this approach slicing can be divided into two steps such as construction of dependence graph of the concern program and implementing a slicing algorithm to produce slices by doing graph reachablity analysis on them.

AOP is a promising new technology for separating crosscutting concerns that are usually hard to do in OOP. Recently, AOP has become the mainstream programming paradigm where real world problems are decomposed into objects that have abstract behaviour and data in a single unit called aspect.

AOP is mainly useful in the area where code scattering and tangling arises. These AOP programs are quite large and complex. This requires to develop efficient slicing algorithms as well as suitable intermediate representations for AOP.

II. SURVEY OF AOP SLICING TECHNIQUES

Program slicing defined by Weiser is in fact a kind of executable backward static slicing. A backward slice consists of all executable statements that the computation at the slicing criteria may depend on, while a forward slice includes all executable statements depending on the slicing criterion. Since 1979, several variants of slicing, which are not static, have been proposed.

Zhao [9] was the first to develop the Aspect-oriented System Dependence Graph (ASDG) to represent aspect oriented programs. The ASDG is constructed by combining the SDG for non-aspect code, the Aspect Dependence Graph (ADG) for aspect code and some additional dependence arcs used to connect the SDG and ADG. Zhao used the two-phase slicing algorithm proposed by Larsen and Harrold [6] to compute static slice of aspect-oriented programs.

D P Mohapatra et al. [5] proposed a dynamic slicing algorithm for aspect-oriented programs, using a dependence-based representation called Dynamic Aspect-Oriented Dependence Graph (DADG) as the intermediate program representation. They have used a trace file to store the execution history of the program.

Ishio et al. [4] evaluated the usefulness of AOP in the area of program analysis. At first, the application of AOP to collecting dynamic

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

information from program execution and calculating program slice was examined. Then, a program slicing system using AspectJ was developed, and benefits, usability, cost effectiveness of the module of dynamic analysis based on AOP was also described.

Ishio et al. [11] proposed an application of a call graph generation and program slicing to assist in debugging. A call graph visualizes control dependence relations between objects and aspects and supports the detection of an infinite loop.

III. Proposed Algorithm For Slicing Aspect-Oriented Programs

A. Motivation

Zhao [9] has proposed an intermediate representation called *Aspect-Oriented System Dependence Graph* (ASDG) for slicing aspect oriented software. This ASDG fails to handle the *point-cuts* properly. Zhao and Rinard [12] developed an algorithm to construct the SDG for aspect-oriented programs. But, the drawback of this SDG is that the *weaving process* is not represented correctly. D P Mahapatra et al. [5] had proposed an algorithm for dynamic slicing of aspect oriented programs. The proposed work based on *Trace file Based Dynamic Slicing* (TBDS) algorithm for AOP's to store the execution history. This algorithm stores the each occurrence of a statement in the execution trace which will take more time as well as space. If a loop will execute for 100 times it will create the 100 vertices for each iteration.

This paper proposes an algorithm for slicing aspect-oriented programs using *Aspect-Oriented Dependence Graph (AODG)* and a new traversing algorithm.

B. Proposed Algorithm

1. *Construction of Aspect-Oriented Dependence Graph (AODG):* Each statement of the program, both aspect as well as non-aspect code will be represented by a vertex in the AODG. AODG consists of four types of arcs
   a. Data dependence arc
   b. Control dependence arc
   c. Weaving arc
   d. Call arc

2. *Computation of Dynamic Slice:* Traverse the graph taking any vertex corresponding to the statement of interest as the starting point of traversal based on the algorithm given in section 3.4 for traversing.

C. Construction of Aspect-Oriented Dependence Graph (AODG)

AOP differ from procedural or object-oriented programming languages in many ways. Some of these differences are the concepts of join points, advice, aspects, and their associated constructs. These aspect-oriented features may have an impact on the development of the dependence-based representation for aspect-oriented software, and therefore should be handled appropriately.

The AODG is a *graph* (*V, A*), where *V* is the set of vertices that correspond to the statements and predicates of the aspect-oriented programs, and *A* is the set of arcs between vertices in *V*. The construction of AODG of an AOP is based on control flow, data flow, weaving of aspect code and function call of the program.

Non aspect code	**Aspect code**

Import java.util.*;
Public class prime {
Private static int n;
1. Public static void main(String args[]){
2. n=Integer.parseInt(args[0]);
3. if(isprime(n))
4. System.out.println("IS PRIME");
else
5. System.out.prontln("IS NOT PRIME");
}
6. Public static boolean isprime(int n){
7. for(int i=2; i<=n/2; i++){
8. If(n%i == 0)
9. return false;
} }
10. return true;
} }
	11. public aspect PrimeAspect {
	12. public pointcut primeoperation (int n): call (boolean prime.isprime(int) && args(n);
	
	13. before (int n): primeoperation(n){
	14. System.out.println("Testing the prime number for " +n); }
	
	15. after(int n) returning (boolean result): promeoperation(n){
	16. System.out.println(showing the prime status for" + n);
	}
	}

Figure-1 (Aspect program to test a number is prime or not)

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Control dependence represents the control flow relationship of a program i.e, the predicates on which a statement or an expression depends during execution [7, 10]. Consider statements s1 and s2 in a source program p if, s1 is a conditional predicate, and the result of s1 determines whether s2 is executed or not then we say that control *dependence (CD)*, from statement s1 to statement s2 exists:

Data dependences represent the data flow relationship of a program i.e, the flow of data between statements and expressions [8, 10]. Consider statements s1 and s2 in a source program p if, s1 defines v, and s2 refers to v, and at least one execution path from s1 to s2 without redefining v exists then we say that *data dependence (DD)*, from statement s1 to statement s2 by a variable v, exists.

Weaving arcs reflect the joining of aspect code and non-aspect code at appropriate join points [5]. *Call arc* represents the function call.

The AODG of the program in Figure-1 is given in Figure-2. In Figure-2, circles represent program statements, dotted lines represent data dependence arcs, solid lines represent control dependence arcs, dark dashed lines represent weaving arcs and dark solid lines represent call arc.

D. Algorithm for traversing

This paper also presents an algorithm to traverse the AODG based on slicing criterion to find the dynamic slice of AOP. The algorithm uses a queue to store the each vertex of AODG and an array to store the traversed vertices. Initially the starting vertex based on slicing criterion will be inserted to the queue. When a vertex is deleted from queue it will be searched in the array if it is not present in the array all its adjacent vertex are inserted to the queue and the deleted vertex is added to array. This process will continue until the queue is empty. Finally vertices in the array give the slice.

1. Insert starting node into the queue (based on slicing criterion)

2. Create an array A to hold the traversed vertices. Initialize temp = queue[front] , ub=1and update the front pointer to delete the front element

3. Repeat while temp != NULL
   a. Intitialize i=0
   b. While ((i < ub) and (A[i]!= temp))
      i. i = i +1
   c. if (i > ub)
      i. ub = ub +1
      ii. A[ub] = temp
      iii. find all the adjacent nodes of temp and add them to queue
   d. temp = queue[front] and update the front pointer.

4. Display all the vertices in array, which gives the slice.

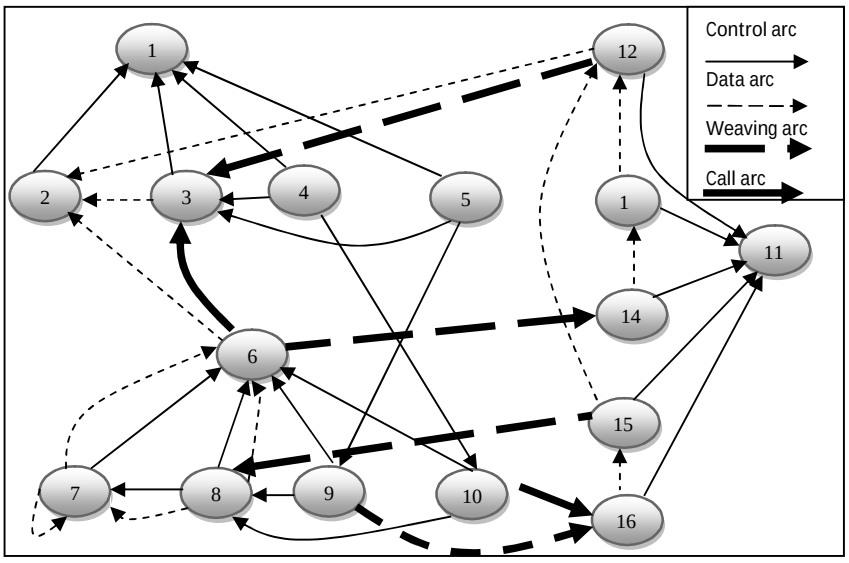


Figure-2 (AODG for the aspect program given in Figure-1)

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

IV. CONCLUSIONS

This paper proposed an approach to slicing aspect oriented software using an Aspect-Oriented Dependence Graph (AODG), which extends previous system dependence graphs, to represent Aspect Oriented Programs. Also this paper proposes an algorithm for traversing the intermediate representation AODG to find the dynamic slice of AOP.

REFERENCES

[1] Baowen Xu Ju Qian Xiaofan Zhang Zhongqiang Wu Lin Chen, A Brief Survey Of Program Slicing Department of Computer Science and Engineering, Southeast University, Nanjing 210096, China, ACM SIGSOFT software engineering notes march - 2005.

[2] Binkley D.W. and Gallagher K.B program slicing. Advances in computer, 43, 1996.

[3] M. Weiser. Program slices: formal, psychological, and practical investigations of an automatic program abstraction method. PhD thesis, University of Michigan, Ann Arbor, 1979.

[4] Takashi Ishio, Shinji Kusumoto, Katsuro Inoue, Application of Aspect-Oriented Programming to Calculation of Program Slice, Graduate School of Information Science and Technology, Osaka University 1-3 Machikaneyama, Toyonaka, Technical report, ICSE – 2003.

[5] Durga Prasad Mohapatra, Madhusmita Sahu and Rajib Mall, Dynamic Slicing of Aspect-Oriented Programs, informatica,2008

[6] Larsen L. and Harrold M. J. Slicing Object-Oriented Software. In *Proceedings of 18th International Conference on Software Engineering*, pages 495–505, March 1996.

[7] Mohapatra D. P., Mall R., and Kumar R. An Edge Marking Technique for Dynamic Slicing of Object-Oriented Programs. In Proceedings of the 28th Annual International Computer Software and Applications Conference (COMPSAC'04), 2004.

[8] Mohapatra D. P., Mall R., and Kumar R. A Node-Marking Technique for Dynamic Slicing of Object-Oriented Programs. In Proceedings of Conference on Software Design and Architecture (SODA'04), 2004.

[9] Jianjun Zhao Slicing Aspect-Oriented Software Department of Computer Science and Engineering Fukuoka Institute of Technology, Fukuoka, Japan, proceedings of the 10th IEEE international workshop on programming comprehension pages 251 – 260 June, 2004

[10] G B Mund and R mall, an efficient dynamic program slicing technique, Information and Software Technology, 2002.

[11] Ishio, Shinji Kusumoto, Katsuro Inoue Debugging Support for Aspect-Oriented Program Based on Program Slicing and Call Graph, Proceedings of the 20th IEEE International Conference on Software Mai1ntenance (ICSM'04), 2004.

[12] Zhao J. and Rinard M. System Dependence Graph Construction for Aspect-Oriented Programs. Technical report, Laboratory for Computer Science, Massachusetts Institute of Technology, USA, March 2003.

AUTHORS PROFILE

Sk. Riazur Raheman has received his Master degree in Computer Application and M.Tech in Comp.Sc. & Engg., from KIIT University, India. He has more than 10 years of teaching experience. He is presently working as Asst. Prof. & HOD of Department of MCA, Raajdhani Engineering College, Bhubaneswar, India. He has published several papers in National & International Conferences. His area of interest includes Program Slicing, Aspect-Oriented Programs, Software Engineering, and Object Oriented Programming.

Abhishek Ray has received his BE in Comp. Sc. from Utkal University, India and ME in Comp. Sc. & Engg from NIT Rourkela, India. Presently he is pursuing Ph.D from KIIT University, India. He has more than 12 years of teaching experience. He is presently working as Asst. Prof. in School of Technology, KIIT University, India. He has guided several M. Tech and B. Tech students. He has published several papers in National & International Conferences & journals. His primary research interest includes Program Slicing, Automata and Software Engineering.

Sasmita Pradhan received her Master degree in Computer Science from Utkal University, India and her M. Tech degree in Computer Science & Engineering from KIIT University, India. She is having more than 5 years of teaching experience. Presently she is working as a Lecturer in Dept. of MCA, Raajdhani Engineering College, Bhubaneswar, India. She has published several papers in National & International Conferences. Her area of interest includes Program Slicing, Aspect-Oriented Programming Fuzzy Logic, and Object-Oriented Systems.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Qualitative Analysis of Hardware Description Languages: VHDL and Verilog

R.Uma
Electronics and Communication Engineering
Rajiv Gandhi College of Engineering and Technology
Puducherry, India
uma.ramadass1@gmail.com

R.Sharmila
Electronics and Communication Engineering
Rajiv Gandhi College of Engineering and Technology
Puducherry, India
sharmeecool@gmail.com

Abstract— The field of electronics has, in the recent decades witnessed unprecedented, explosive and exciting progress. Several monumental changes have occurred in the design structure and execution of electronics principles. In the design process the functionality is defined through Hardware Description Language (HDL) especially Very High Speed Hardware Description Language (VHDL) and Verilog. A single chip is modeled by a large number of solid state devices and integrated circuits incorporating millions of active devices, these devices can be developed by using HDLs. VHDL on the other hand is evolved by incorporating and integrating ADA and Pascal language whereas Verilog is based on C language. These languages differ in different aspects bring a large differences between them in terms of their content, structure, reusability, portability, cost and so on. These differences also produce implementation issues. A comparison of the distinguishing characteristics in their entire ramification would help to frame future research in the field of electronics. In this direction, this paper attempts on an analysis of these languages will also help us to determine the relative superiority among these languages.

Keywords- HDL, VHDL, Verilog, performance evaluation

I. INTRODUCTION

The word digital has made a dramatic impact on our society. More significant is a continuous trend towards communication, business transactions, traffic control, space guidance, medical treatment, weather monitoring, the internet and many other commercial, industrial and scientific enterprises. Development of such solutions has been possible due to good digital system design and modeling techniques. In electronics, a Hardware Description Language or HDL is a language for formal description of standard text-based expressions of the spatial and temporal structure and behavior of electronic systems. It describes the behavior of an electronic circuit or system from which the physical circuit or system can then be attained. The principal feature of a HDL is that it contains the capability to describe the function of hardware independent of implementation. A HDL is analogous to a software programming language, but with major differences. Many programming languages are inherently procedural (single-threaded), with limited syntactical and semantic support to handle concurrency. HDLs, on the other hand, resemble concurrent programming languages in their ability to model multiple parallel processes (such as flip-flops, adders, etc.) that automatically execute independently of one another.

HDLs have two purposes. First, they are used to write a model for the expected behavior of a circuit before that circuit is designed and built. The model is fed into a simulator, which allows the designer to verify that the design behaves correctly. Second, they are used to write a detailed description of a circuit that is fed into a logic compiler. The output of the compiler is used to configure a programmable logic device that has the desired function. Often, the HDL code that has been simulated in the first step is re-used and compiled in the second step. There are many proprietary HDLs in use today, but there are only two standardized and widely used HDLs: Verilog and VHDL.

The organization of the paper is as follows: the section 2, describe the background information of the VHDL and Verilog. The section 3, describes the HDL design flows. The section 4, presents the analysis of the VHDL and Verilog with various parameters like capability, constructs, data types, low-level modeling, high-level modeling, operators, library, forward-backward annotation, timing variables, procedure and tasks, compilation and commercial aspects are broadly distinguished between VHDL and Verilog.

II. BACKGROUND

VHDL: VHDL was developed by committee intended for documenting digital hardware behaviorally. The requirements for the language were first generated in 1981 under the VHSIC (Very High Speed Integrated Circuit) program as part of a US DOD (Department of Defense) project. In 1983 the DOD awarded a contract with a team of three companies, IBM, Texas Instruments, and Intermetrics to develop a version of the language. It was known as VHDL 7.2 and was completed in 1985. Consequently, the language was transferred to the IEEE for standardization in 1986. After a substantial enhancement to the language it has become IEEE standard 1076 in 1987 [1]. The deficiencies of this language lack in the modeling of gate and transistor level and there was no facility for handling timing information. But due to the lack of ASIC libraries and slower gate level simulation performance, people use VHDL mainly for behavioral simulation, then synthesize or translate the design to another simulation environment to run gate level sign-off simulation. The design community proposed a methodology to help VHDL move towards a more

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

useful design language. This initial effort was called the VHDL Initiative Towards ASIC Libraries, or VITAL 2.2B is designed to solve this key problem.

Verilog: The Verilog HDL was first developed by Gateway Design Automation in 1983 as a hardware modeling language for their simulator product. When cadence purchased the Verilog assets from Gateway in 1989, Verilog HDL and simulation tools became popular and gained acceptance as a usable and practical language by a number of designers. In 1990 Verilog HDL was placed into public domain and since then end-users, semiconductor companies and EDA (Electronic Design Automation) companies have directly benefited from this open availability. In the same year Open Verilog International (OVI) was formed to promote Verilog. They have improved the Verilog HDL documentation set and enhanced and extended the language for use with new technologies. In 1992, OVI decided to pursue standardization of Verilog HDL as an IEEE standard. In 1995 the language was standardized by IEEE [IEEE Std 1364-1995] [2].

III. HDL DESIGN FLOW

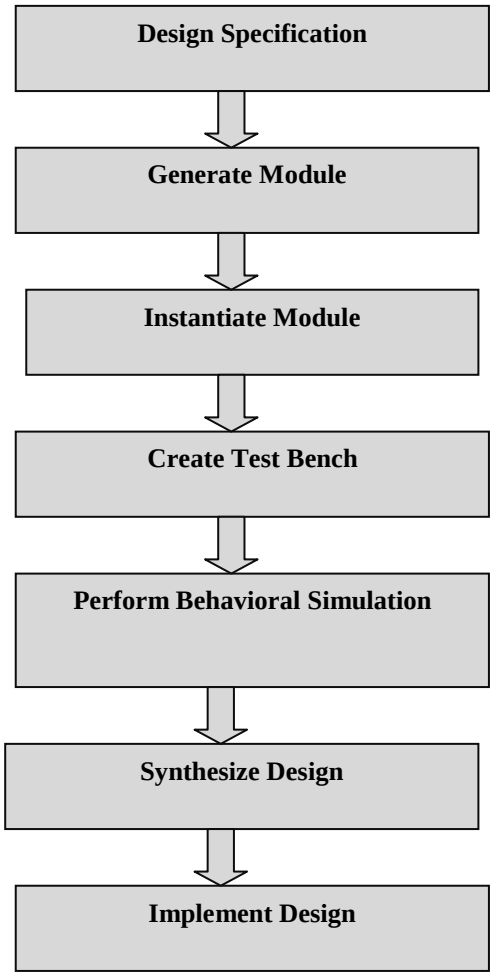


Figure 1 HDL Design Flow

In any design, specifications are written first, specifications describe abstractly the functionality, interface and overall architecture of the digital circuit to be designed. The next step in evolving the design description is to describe the circuit in terms of its behavior. The design at the behavioral level is to be elaborated in terms of known and acknowledge functional blocks. It forms the next detailed level of design description. Once again the design is to be tested through simulation and iteratively corrected for errors. The elaboration can be continued one or two steps further. Logic synthesis tools convert the RTL description to a gate-level netlist. A gate-level netlist is a description of the circuit in terms of gates and connections between them. Synthesis is a process by which an abstract form of desired circuit behavior (typically register transfer level (RTL)) is turned into a design implementation in terms of logic gates. Logic synthesis tool ensure that the gate level netlist meets timing, area and power specifications. After several annotation if the expected output is derived then the final implementation is done through FPGA or ASIC. Figure 1 depicts the general HDL design flow.

IV ANAYSIS OF VHDL AND VERILOG HDL

A. *Major Capabilities*

- *Standard: VHDL*: Has its standardization from IEEE and ANSI [1]. *Verilog:* Has its standardization from IEEE and non-propriety [2].
- *Language: VHDL:* Language is developed from ADA and Pascal [5]. *Verilog:* Language is developed from C [5].
- *Case sensitive: VHDL:* It is a strongly typed language, and scripts that are not strongly typed, are unable to compile. A strongly typed language like VHDL does not allow the intermixing, or operation of variables with different clause. *Verilog:* uses weak typing and is case sensitive. It affords the designer a simple language syntax and structure. Because it only supports scalar data types, it was possible for the language to perform the correct type conversions automatically [9]
- *Design Methodologies: VHDL:* The language supports flexible design methodologies: top-down, bottom-up, or mixed that aid in high-level modeling and it reflects the actual operation of the device being programmed. *Verilog:* Supports both top-down and bottom-up methodologies.
- *Data types: VHDL:* Complex data types and packages are very desirable when programming big and complex systems that might have a lot of functional parts. *Verilog:* Simple data types, they are the net and register data types.
- *General styles of description: VHDL:* There are three general styles of description: structural, dataflow and behavioral. A design can also be implemented by

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

mixing all the three styles. *Verilog:* A design can be modeled in four different styles or in a mixed style. These styles are behavioral, dataflow, gate-level, and switch-level modeling.

- *Timing Analysis: VHDL:* It supports both synchronous and asynchronous timing models. Nominal propagation delays, min-max delays, setup and hold timing, timing constraints, and spike detection can all be described very naturally in this language [7,8]. *Verilog:* The timing verification and delays like min-max, pin-to-pin delays can be evaluated through analyzer and the system directives.
- *Range of abstraction levels: VHDL:* It supports abstraction levels ranging from abstract behavioral descriptions to very precise gate-level descriptions. It does not support modeling below the transistor level. *Verilog:* A design can be described from switch-level, gate–level, register- transfer-level (RTL) to algorithmic-level, including process and queuing-level.
- *Test bench model: VHDL:* Effective testing methodology can be achieved by developing test bench model to test the MUT (Model Under Test) at the behavioral level of abstraction can be reused to test the MUT at the lower levels as well. This feature ensures this language is reusable. *Verilog:* Verilog hierarchical referencing (also referred to as Cross-Module-Referencing or XMR or CMR), is a feature that is extensively used in Verilog test benches. This feature allows simple probing into or monitoring of buried signals without requiring that the signals be routed to the top of design for observation.
- *Annotations: VHDL:* Generics and attributes are useful in facilitating the back-annotation of static information such as timing or placement information and also useful in describing parameterized designs. *Verilog:* **:** Verilog HDL supports the analysis of critical path delay in a module by specifying through the timing parameters in that block. The Standard Delay Format (SDF) in Verilog HDL provides the essential back annotation facility for loading post route delay calculation.
- *Communication Medium: VHDL*- The language can be used as a communication medium between different CAD and CAE tools and also used as an exchange medium between chip vendors and CAD tools users. *Verilog*- The Programming Language Interface (PLI) is a powerful feature that allows the user to write custom C code to interact with the internal data structures of Verilog. Designers can customize a Verilog HDL simulator to their needs with the PLI [6].

Analysis: The two languages have different technical strengths which significantly differentiates their market focus. The technical capabilities based solely on ease of use, timing and commercial issues. The following graph (Figure 2) highlights the language's spectrum with respect to the levels of abstraction. The summary of major capabilities of VHDL and Verilog are listed in Table 1.

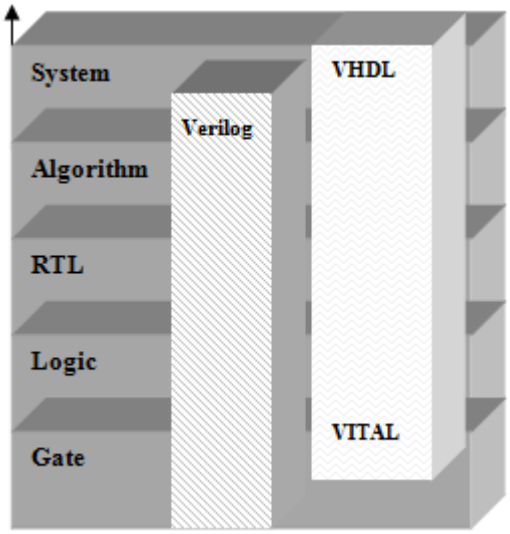


Figure 2 Level of Abstraction

Table 1 Summary of major capabilities of VHDL and Verilog

Capabilities	VHDL	Verilog
Standardization	IEEE and ANSI	IEEE and non-propriety
Language	ADA & Pascal	C
Case Sensitive	Case-insensitive	Case sensitive
Design methodologies	Top-down, bottom-up, mixed	Top-down, bottom-up, mixed
Data Types	Complex	Simple
Modeling	Behavioral, data, structural	Gate, switch, data, behavioral
Timing analysis	min-max delays, setup and hold timing,	min-max delays, setup hold timing and pin-to-pin delay
Abstraction level	Behavioral to gate	Behavioral to transistor
Test bench model	Available	Available
Annotations	Generics and attributes	Standard Delay Format
Communication medium	CAD and CAE	PLI

B. Fundamental difference in constructs

VHDL: A hardware abstraction of the digital system is called an entity in VHDL. To describe an entity, VHDL provides five different types of primary constructs called design unit. They are

1. Entity declaration
2. Architecture body
3. Configuration declaration
4. Package declaration
5. Package body

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Verilog*:* The construction of Verilog cell model is fairly straightforward. It generally consists of the following parts:

1. Module declaration
2. Ports declaration
3. Variables and registers declaration
4. Functionality definition

Analysis: Verilog HDL affords the designer a simple language syntax and structure. This capability, unlike VHDL, allows the designer to learn the language quickly and develop more concise and effective models. The constructs of VHDL and Verilog model is presented in Figure 3.

```
entity NAME_OF_ENTITY is [ generic generic
declaration);]
        port (signal_names:mode_type;
                        :
                        :
              signal_names:mode_type);
end [NAME_OF_ENTITY];
architecture ARCHITECTURE_NAME of
NAME_OF_ENTITY is
    [architecture_item_declaration]
      - component declarations
      - signal declarations
      - constant declarations
      - function declarations
      - procedure declarations
      - type declarations
begin
        concurrent statement; these are -->
        process-statement
        block statement
        concurrent-procedure-call - statement
        concurrent-assertion-statement
        concurrent-signal-assignment-statement
        component-instantiation-statement
        generate statement
end ARCHITECTURE_NAME;
```

a) Construct of VHDL

```
module NAME_OF_MODULE  [ port associations];
              -  port declarations;
              -  data type declarations
              -  parameter declarations
              -  functionality declarations
                    --continuous assignment statements
                  --procedural assignment statements
endmodule
```

b) Construct of Verilog

Figure 3 General constructs of VHDL and Verilog HDL

C. Data types

- *Standard data types: VHDL:* In VHDL a data object is created by an object declaration and has a value and type associated with it. They are scalar, composite, access and file data types. *Verilog:* Verilog HDL affords the designer a simple data types to model a hardware structure. There are two data types in Verilog HDL; the net and the register data types. The net type represents a physical connection between structural elements while a register type represents an abstract data storage element.

- *Data objects: VHDL:* The data objects are constant, variable, signal and file. *Verilog:* The data objects are integer, real and string.

- *Signal Values and Strength: VHDL:* The signals and variables in VHDL are defined with the combination of 9 values. *Verilog:* It supports four values and eight strengths to model the functionality of real hardware. They are logic 0, logic 1, unknown logic x and floating state z. In addition to logic values, strength levels are often used to resolve conflicts between drivers of different strengths in digital circuits.

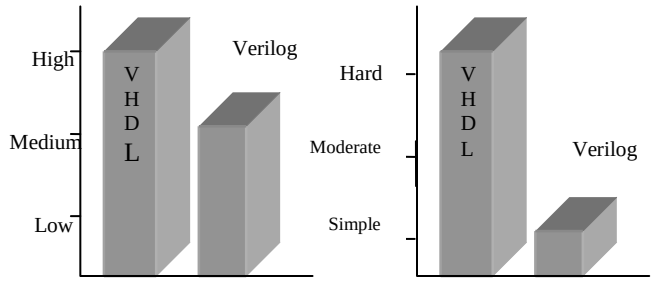
- *Packages: VHDL:* VHDL is a strongly typed language that requires each object to be of a certain type. In general one is not allowed to assign a value of one type to an object of another data type. To allow assigning data between objects of different types, one needs to convert one type to the other. Fortunately there are functions available in several packages in the IEEE library, such as the std_logic_1164 and the std_logic_arith packages. *Verilog:* There is no concept of packages in verilog.

- *Abstract data type: VHDL:* The language provides the facility to define new data types called enumerated data types consists of list of characters, literals or identifiers. The enumerated type can be very handy when writing models at abstract level. *Verilog:* There is no abstract data type.

- *Pre-defined data types: VHDL:* The predefined data types are bit, bit_vector, Boolean, character and open. *Verilog:* Almost all the data types are predefined like and, or, wand, pullup, pulldown and so on.

Analysis: Multiple data types available in VHDL but type conversion is required for compatibility where as Verilog has only two data types and the conversion is taken care automatically by the compilers. Hence Verilog may be preferred because of its simplicity. Comparison result based on ease of use and multiple availability is shown in Figure 4. The data types of VHDL and Verilog is listed in the Table 2.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500



a) Multiple availability of data types **b) Ease of use**

Figure 4 Comparison result based on ease of use and multiple availability

Table 2 Data types of VHDL and Verilog

	VHDL	Verilog
Standard data types	Scalar, composite, access, file	Wire and reg
Data objects	Constant, variable, signal, file	Integer, real, string
Signal values and strengths	Uninitialized 'U' Forcing unknown 'X' Forcing 0 '0' Forcing 1 '1' High impedance 'Z' Weak unknown 'W' Weak 0 'L' Weak 1 'H' Don't care '-'	Logic 0, logic1, unknown logic x, floating state z. STRENGTHS: supply drive, strong drive, pull drive, large capacitance, weak drive, medium capacitance, small capacitance, high impedance.
Packages	STANDARD, TEXTIO, ATT_MVL, STD_LOGIC_1164, UTILS_PKG, STD_LOGIC_ARITH	No concept of packages
Abstract data types	Enumerated	No abstract data type
Pre-defined data types	bit, bit_vector, Boolean, character and open	All data types are pre-defined.

D. Low-level Modeling

VHDL: VHDL is used mainly for system design at behavioral and RTL levels. The language is defined with predefined logical operators to enhance the specification of primitive gates like NOT, AND, OR, NAND, NOR, XNOR. The introduction of VITAL specifications using VHDL for gate-level simulation has become effective [10].

Verilog: Verilog provides the ability to design the leaf-level modules at a MOS-transistor level. Digital circuits at the MOS-transistor level are described with nmos, pmos, cmos, tran, tranif0, tranif1, supply0, supply1, rnmos, rcmos etc. this language provides specification for modeling the cell primitives of ASIC and FPGA libraries. Verilog provides a standard set of primitives, such as and, nand, or, nor, not as a part of the language. These are also commonly known as build-in primitives. However, designers occasionally like to use their own custom-built primitives when developing a design. Verilog provides the ability to define User-Defined-Primitives (UDP). These primitives are self-contained and do not instantiate in other modules or primitives.

Analysis: low-level modeling is not possible without VITAL in VHDL with additional burden of memory occupation. Low-level modeling is a in-built feature of Verilog. The comparison of low-level modeling is depicted in Figure 5.

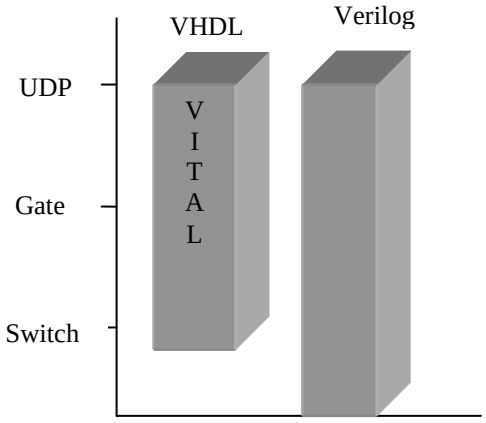


Figure 5 Comparison of Low-level modeling

E. High-level Modeling

VHDL: VHDL provides means to represent digital circuits at different levels of representation of abstraction, such as the behavioral and structural modeling. High-Level modeling can be implemented with the package, configuration, generate and generic statements. A package statement specifies the encapsulation of set of related declaration, subtype declaration and sub program declarations, which can be shared across two or more design units. This feature enables the model reusability. A configuration statement specifies the binding of one architecture body from many architecture bodies that may be associated with the entity. This feature enables to specify multiple views for a single entity and use any one of these for simulation. Any important device and system parameters which required to be changed at different abstraction levels were declared as generic statements, and the values for these were provided only in the configuration file. The generate statement provides the replication of the design structure during the elaboration phase. Generate statement resembles a macro expansion, used to provide a compact description of a regular structure such as memories, registers and counters. The advanced statements for designing high level constructs include:

- Alias statement provides a convenient short hand notation for items that have long names.
- Shared variable statements are used to access a variable that is declared outside of a process or a subprogram.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Verilog: Verilog provides the designer the ability to describe the design functionality in an algorithmic manner with the following statements:

- Parameter statements are used to define a constant value in a module
- Defparam is used to change parameter values in any module instance
- Assign and deassign, force and release statements are the procedural statements used to evaluate and invoke the expressions.
- Verilog provides lot of system directives which is not available in VHDL.

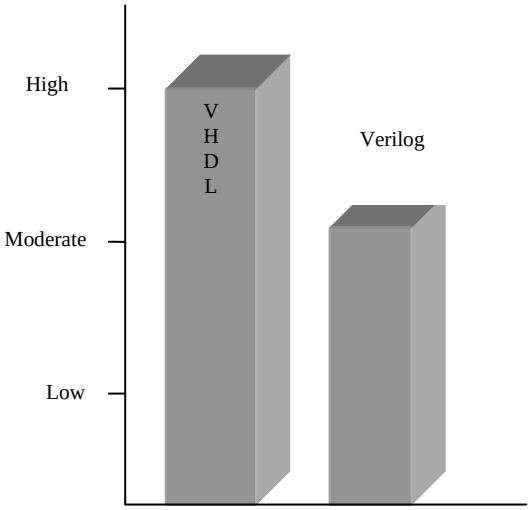


Figure 6 Comparison of high-level modeling

Analysis: Except for being able to parameterize models, there is no equivalent to the high – level VHDL modeling statements in Verilog. The comparison result is shown in Figure 6.

F. Operators

VHDL: The predefined operators in the language are logical, relational, shift, concatenation, multiplying operators and miscellaneous operators.

Verilog: Verilog provides many different operator types. There are arithmetic, logical, relational, equality, bitwise, reduction, shift, concatenation, replication and conditional (ternary) operator.

Analysis: The majority of the operators are the same between the two languages. The operator that is not available in Verilog is absolute operator. Verilog has bitwise reduction, replication, equality and conditional operators that are not found in VHDL. For reduction operation normally loop statement is incorporated in the design. The comparison is listed in Table 3.

Table 3 Comparison of Operators

HDL	Arithmetic	Logical	Relational	Equality	Bitwise	Reduction	Shift	Concatenation	Replication	Ternary	miscellaneous
VHDL	Yes	Yes	Yes	No	No	No	Yes	Yes	No	No	Yes
Verilog	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

G. Library

VHDL: A library can be considered as a place where the complier stores information about a design project. A VHDL library contains a file or module that contains declarations of commonly used objects, data type, component declarations, signal, procedures, functions, compiled entities, architecture, packages and configurations that can be shared among different VHDL models. A design library is implemented on a host system as a file directory, and the complied design units are stored as in this directory. The management of the design libraries is also not defined by the language and is again tool-implementation-specific [14]. An arbitrary number of design libraries may be specified. These libraries are useful for managing multiple design projects.

Verilog: Verilog has only standard cell library containing simple cells, such as basic logic gates like and, or, nor, or macro cells, such as adders, muxes, and special flip-flops. A standard cell library is also known as the technology library [15]. Therefore the Verilog language has no concept of creating library as compared to VHDL language.

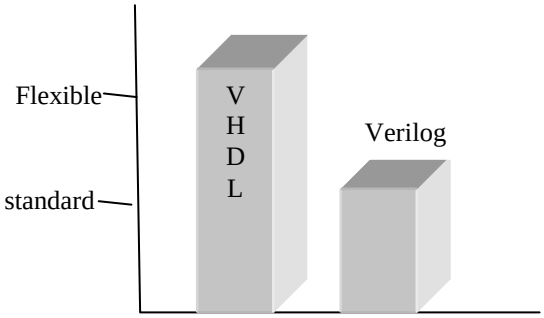


Figure 7 Comparison based on Library

Analysis: VHDL language has standard library as well as flexibility to create user defined library, which is the deficiency feature in Verilog language other than standard cell library. The comparison is depicted in the Figure 7.

H. Forward and backward annotation

The Standard Delay Format (SDF) was designed to serve as a simple textual medium for communicating timing information

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

and constraints between EDA tools. Verilog HDL supports the analysis of critical path delay in a module by specifying through the timing parameters in that block, and the annotation is performed with SDF. This feature is a deficit in VHDL but annotation is possible through generic statement and CAD tool support [13].

I. Timing Variables

VHDL: Functional verification and delays associated with the logic elements are analyzed using static timing verification. The timing and delay can be evaluated using after and wait clause. The delay models supported by VHDL are inertial and transport delay module.

Verilog: The timing verification and delays can be evaluated using distributed, lumped and pin-to-pin delays and the timing checks can be analyzed using the directives $setup, $hold, $setuptask, $holdtask and $width [10] where $ symbol represents it's a complier directive.

Analysis: Timing verification and annotations are predefined in Verilog through system function and complier directives through SDF. These features are possible in VHDL with inclusion of VITAL library. The comparison of timing analysis is shown in Table 4.

Table 4 Comparison of Timing analysis

Parameters	Verilog	VHDL with Vital library
Timing Checks	$setup $hold $width $period $skew N/A $recovery $setuphold $nochange N/A N/A	Tactup thold tpw tperiod tskew release recovery setup, thold N/A tdevice tpulse
Timing Check Control	Available	Available
Timing Violation Mesg.	Available	Available
Violation highlights	Flag	Flag
Wire delay	None	Each input pin
Pin-to-pin delay	Min,typ,max	One choice
Delay models	Distributed Lumped Pin-to-pin	Inertial Transport
Edge-control spec.	Available	Available

J. Procedures and Tasks

Large design units are managed using configuration, generate, generic, package, functions and procedures which run concurrently in VHDL which enhance the reusability of design unit. There is no concept of package in Verilog. The functions and procedures used in a module have the scope only to that module. To have global access the functions and procedures are placed in the system file and it is invoked through the directive called `include in the other module. Verilog does not allow concurrent task calls.

K. Compilation

VHDL: The design descriptions are validated using analyzer and simulators. The input to the analyzer is the design file containing entity, architecture, package and configuration.
During compilation the analyzer checks the syntax and semantic checks. The design file is converted into intermediate format and is stored in the design library which is called the working library. The complied descriptions are normally stored in the host environment [12]. The primary advantage of this compilation is that multiple design units will be resided in the same file. The compilation process is shown in Figure 8.

Verilog: The design descriptions are validated using HDL Compiler which checks the syntax and translates Verilog language hardware descriptions to the internal design format. Design Compiler can then optimize the design and map it to a specific ASIC technology library, as shown in Figure 9.

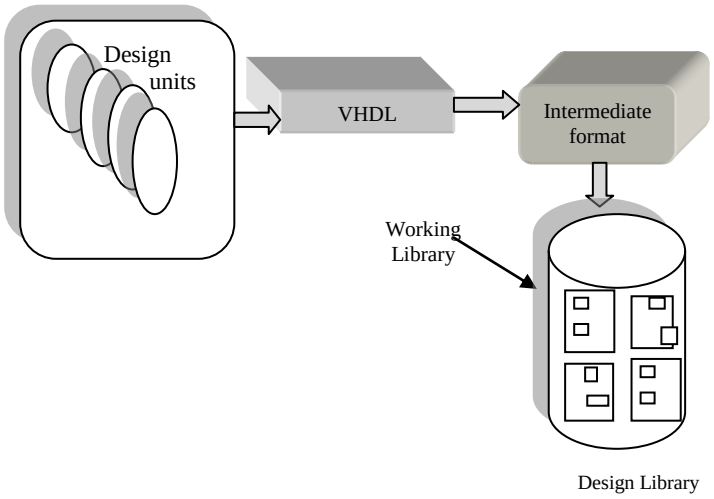


Figure 8 Compilation Model of VHDL

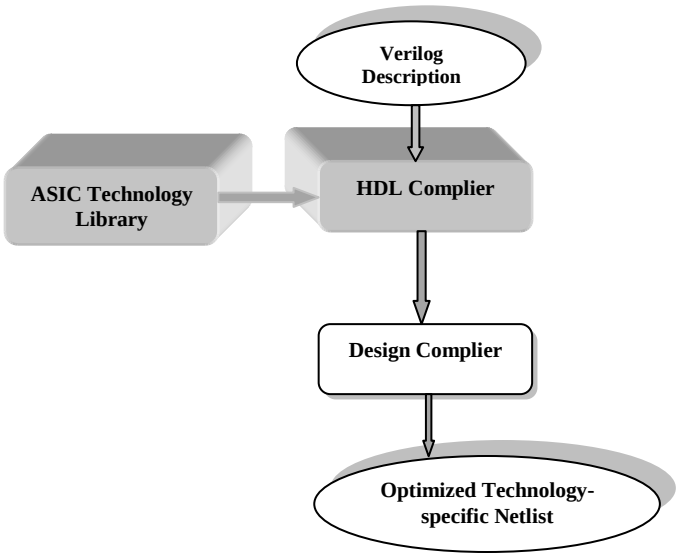


Figure 9 Compilation Model of Verilog

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Analysis: VHDL inherits multiple design units under the same system file in which the compilation works isolated. In Verilog the operation of compilation cannot be predicted since single and multiples may reside in different locations within the system, so to speed up the simulation process the compilation order should be taken care of.

V ANAYSIS BASED ON COMMERICAL ASPECTS

EDA Tool Support: According to EDA companies, VHDL is flexible in incorporating their technology core in them. Even though it has the constrain of transistor and gate levels and lacks to provide timing information it has been widely promoted by these companies as they had their own property HDL's integrated within their own simulation, they elected to promote VHDL. On the other side, Verilog HDL lost its fame due to the reason that it has its intellectual property of gateway design automation.

Timing Analysis: Verilog HDL supports the analysis of critical path delay in a module by specifying through the timing parameters in that block. The Standard Delay Format (SDF) in Verilog HDL provides the essential back annotation facility for loading post route delay calculation, a utility not available in VHDL. Presently Verilog models or simulation is used for "sign-off" by any semiconductor company to fulfill the needs of ASIC foundry cell, which is lacked by VHDL language [4]. Verilog HDL has the ability to access a variable in the design module to analyze the characteristics of the signal externally. In VHDL the communication is completely dependent on the signal values.

Impact on Synthesis: In Verilog HDL most of the statements are synthesizable without the need of a special "package", eliminates the need or large degrees of parameterization. VHDL must be highly parameterized when developing models that are synthesizable [15].

Technical Strength: VHDL supports the design representation of hardware by nature. The analog representation is accomplished through the support of VITAL library specifications. This library requires almost 50x more memory to run than the equivalent Verilog HDL description of the same model and the simulation speed is about 50 to 100 longer than the same Verilog based simulation run [3]. This resultant performance is not appreciated for commercial aspect.

The language is strongly typed and complex. Hierarchical testing is a significant deficiency in VHDL. In Verilog the primary technical strength is that any design can be modeled in digital and analog representation. A hardware designer can expect the intended design module as per the requirements. This is possible due to the in-build predefined hardware net and register type. Gate and switch level modeling meets the constraints of ASIC and FPGA foundry cells. The second technical strength is its simplicity of language syntax and structure. Ease in translating the design into supported simulation environments and their performance characteristics. The third technical strength aspect is that simulation time and the memory consumption during compilation is very less [11]. The last strength is the hierarchical referencing feature is extensively used in Verilog test benches which allow simple probing into or monitoring of buried signals without requiring that the signals be rooted to the top of the design for observations. The comparison based on technical strength is listed in Table 5.

Table 5 Comparison based on Technical Strength

	VHDL	Verilog
Language structure	Complex	Simple
Performance	Better	Best
Simulation	50x than Verilog	Fast
Memory Occupation	More	Less
Testing	Deficiency	Hierarchical testing

VI SUMMARY

This article has attempted to highlight the structural differences between two major languages namely VHDL and Verilog. VHDL is mainly used for behavioral simulation. Synchronous and asynchronous timing models can be accurately designed. Modeling can have high level of abstraction. It can be used as communicating medium for CAD and CAE. On the other hand Verilog is a non-propriety language having simple structure and constructs. All functions are pre-defined in the library. Low-level modeling like gate and switch can be easily constructed. Hierarchical referencing can be used to monitor the signals in a module. The basic differences between these languages are briefly summarized in the following Table 6.

Table 6 Overall Comparisons

	VHDL	Verilog
Case sensitive	No Strongly Typed	Yes Weakly Typed
Language	Pascal ADA	C
Abstraction Level	High	Moderate
Design reusability	Yes, due to procedures and functions	Possible through `include directive
Easiest to learn	Less Intuitive	Ease
Structure of Language	Abstract	Simple
PLI	No	Yes

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

	VHDL	Verilog
Hierarchical Referencing	No	Yes
UPD	Yes with VITAL	Yes
Packages	Yes	No
Enumerated Data types	Yes	No
Data types	Multiple availability	Simple and has 2 data types
Low-level constructs	Better with VITAL	Excellent and it is predefined

	VHDL	Verilog
High-level Constructs	Excellent	Good
Replication	Yes with generate statement	No
Operators Not available	Bitwise reduction, Replication, Equality, conditional (ternary)	absolute
Library	Standard and flexible to create user defined library	Standard
Annotation	Deficit	Through SDF
Timing analysis	Possible with VITAL	In-build feature

	VHDL	Verilog
Compilation Process	Good	Deficit
Parameterization	High	No
Memory occupation	50x More	Less
Speed	Less	High
performance	Moderate	Good
Revenue	Moderate	More Profitable

VI CONCLUSION

Search for the perfect HDL should rely upon the factors like ease of use, ease of learning, future usability, adaptability, technical strengths commercial aspects as well as technology preferred by the company. Beginners' designers may want to start with Verilog (even over VHDL) as it has simple structure and syntax. The primary advantage of this language is modeling of gate and transistor level which satisfies the ASIC and FPGA foundries. It has in-build system compliers and SDF tools which supports optimization and annotation. Its memory occupation for the simulation process is less and speed is high and enhances the performance. On the other hand VHDL language structure is abstract. The basic strength of this language is that the design can be implemented with high level of abstraction. It has the concept of reusability and can be established using packages and libraries. The deficiency of this language lacks in low level constructs, timing analysis, memory, speed, performance when compare to Verilog.

REFERENCES

1. IEEE Standard VHDL Language Reference Manual, IEEE Std 1076, 2000 Edition
2. IEEE Std 1364-1995, IEEE Standard Hardware Description Language Based on the Verilog Hardware Description Language.
3. Clifford E. Cummings, "Efficient Verilog Memory Modeling Using DAMEM," International Cadence Users Group Conference 1995
4. Douglas. J. Smith, "HDL Chip Design," Doone Publications, Madison, AL., January 1997.
5. IEEE Standard Verilog Hardware Description Language, IEEE Computer Society, IEEE, New York, NY, IEEE Std 1364 – 2001.
6. Hardware Description Languages Compared : Verilog and System C
7. Baker, L., VHDL Programming with Advanced Topics, John Wiley and Sons, Inc., 1993.
8. Bhasker, J., A VHDL Synthesis Primer, Allentown, PA: Star Galaxy Publishing, 1995
9. System Verilog – Is This The Emerging of Verilog and VHDL? Clifford E.Cummings
10. A Comparison between Verilog and VITAL Modeling in ASIC Library toward SIGN-OFF, May Huang.
11. A Comparison of VHDL and VERILOG Resource usage by Behavioral Memory Models, Richard Munden.
12. IP Reuse: A Novel VHDL to verilog Translation Flow, Alessandor Fasan.
13. VHDL and VERILOG Compared and Contrasted – Plus Modeled Example Written in VHDL, Verilog and C, Douglas. J. Smith.
14. VHDL Primer, J. Bhasker.
15. Verilog HDL, A Guide to Digital Design And Synthesis, Samir Palnitkar

AUTHORS PROFILE

She is graduated B.E (EEE) from Bharathiyar University Coimbatore in the year 1998, Post graduated in M.E (VLSI Design) from Anna University Chennai in the year 2004. Currently she has been working as Assistant Professor in Electronics and Communication Engineering, Rajiv Gandhi College of Engineering and Technology, Puducherry. She has been teaching VLSI Design, Embedded Systems, Microprocessor and Microcontrollers for PG and UG students. She authored books on VLSI Design. She has published several papers on national conference and symposium. She is the guest faculty for Pondicherry University for M.Tech Electronics. He has been actively guiding PG and UG students in the area of VLSI, Embedded and image processing. She has received the best teacher award for the year 2006 and 2007. Her research interests are Analog VLSI Design, Low power VLSI Design, Testing of VLSI Circuits, Embedded systems and Image processing. She is a member of ISTE.

Sharmila.R received her B.E (Electronics & Communication Engineering) from Annamalai University in 2006 & M.E (Computer & Communication Engineering) from Anna University in 2010. Currently she has been working as a lecturer in the Department of Electronics and Communication Engineering in Rajiv Gandhi College of Engineering & Technology Puducherry .Her area of interests are image processing and wireless sensor network. She is a member of ISTE.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Data Mining: A prediction for performance improvement using classification

Brijesh Kumar Bhardwaj
Research Scholar, Singhaniya University,
Rajasthan, India
wwwbkb@rediffmail.com

Saurabh Pal
Dept. of Computer Applications,
VBS Purvanchal University,
Jaunpur (UP) - 224001, India
drsaurabhpal@yahoo.co.in

Abstract—**Now-a-days the amount of data stored in educational database increasing rapidly. These databases contain hidden information for improvement of students' performance. The performance in higher education in India is a turning point in the academics for all students. This academic performance is influenced by many factors, therefore it is essential to develop predictive data mining model for students' performance so as to identify the difference between high learners and slow learners student.**

In the present investigation, an experimental methodology was adopted to generate a database. The raw data was preprocessed in terms of filling up missing values, transforming values in one form into another and relevant attribute/ variable selection. As a result, we had 300 student records, which were used for by Byes classification prediction model construction.

Keywords- Data Mining, Educational Data Mining, Predictive Model, Classification.

I. INTRODUCTION

The ability to predict a student's performance is very important in educational environments. Students' academic performance is based upon diverse factors like personal, social, psychological and other environmental variables. A very promising tool to attain this objective is the use of Data Mining. Data mining techniques are used to operate on large amount of data to discover hidden patterns and relationships helpful in decision making.

In fact, one of the most useful data mining techniques in e-learning is classification. Classification is a predictive data mining technique, makes prediction about values of data using known results found from different data [1]. Predictive models have the specific aim of allowing us to predict the unknown values of variables of interest given known values of other variables. Predictive modeling can be thought of as learning a mapping from an input set of vector measurements to a scalar output [4]. Classification maps data into predefined groups of classes. It is often referred to as supervised learning because the classes are determined before examining the data.

Prediction models that include all personal, social, psychological and other environmental variables are necessitated for the effective prediction of the performance of the students. The prediction of student performance with high accuracy is beneficial for identify the students with low academic achievements initially. It is required that the identified students can be assisted more by the teacher so that their performance is improved in future.

In this connection, the objectives of the present investigation were framed so as to assist the low academic achievers in higher education and they are:

(a) Generation of a data source of predictive variables,

(b) Identification of different factors, which effects a student's learning behavior and performance during academic career

(c) Construction of a prediction model using classification data mining techniques on the basis of identified predictive variables and

(d) Validation of the developed model for higher education students studying in Indian Universities or Institutions.

II. BACKGROUND AND RELATED WORK

Data Mining can be used in educational field to enhance our understanding of learning process to focus on identifying, extracting and evaluating variables related to the learning process of students as described by Alaa el-Halees [2]. Mining in educational environment is called Educational Data Mining.

Han and Kamber [6] describes data mining software that allow the users to analyze data from different dimensions, categorize it and summarize the relationships which are identified during the mining process.

Pandey and Pal [10] conducted study on the student performance based by selecting 600 students from different colleges of Dr. R. M. L. Awadh University, Faizabad, India. By means of Bayes Classification on category, language and background qualification, it was found that whether new comer students will performer or not.

Hijazi and Naqvi [7] conducted as study on the student performance by selecting a sample of 300 students (225 males, 75 females) from a group of colleges affiliated to Punjab university of Pakistan. The hypothesis that was stated as "Student's attitude towards attendance in class, hours spent in study on daily basis after college, students' family income,

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

students' mother's age and mother's education are significantly related with student performance" was framed. By means of simple linear regression analysis, it was found that the factors like mother's education and student's family income were highly correlated with the student academic performance.

Khan [8] conducted a performance study on 400 students comprising 200 boys and 200 girls selected from the senior secondary school of Aligarh Muslim University, Aligarh, India with a main objective to establish the prognostic value of different measures of cognition, personality and demographic variables for success at higher secondary level in science stream. The selection was based on cluster sampling technique in which the entire population of interest was divided into groups, or clusters, and a random sample of these clusters was selected for further analyses. It was found that girls with high socio-economic status had relatively higher academic achievement in science stream and boys with low socio-economic status had relatively higher academic achievement in general.

Galit [5] gave a case study that use students data to analyze their learning behavior to predict the results and to warn students at risk before their final exams.

Al-Radaideh, et al [1] applied a decision tree model to predict the final grade of students who studied the C++ course in Yarmouk University, Jordan in the year 2005. Three different classification methods namely ID3, C4.5, and the NaïveBayes were used. The outcome of their results indicated that Decision Tree model had better prediction than other models.

Pandey and Pal [11] conducted study on the student performance based by selecting 60 students from a degree college of Dr. R. M. L. Awadh University, Faizabad, India. By means of association rule they find the interestingness of student in opting class teaching language.

Bray [2], in his study on private tutoring and its implications, observed that the percentage of students receiving private tutoring in India was relatively higher than in Malaysia, Singapore, Japan, China and Sri Lanka. It was also observed that there was an enhancement of academic performance with the intensity of private tutoring and this variation of intensity of private tutoring depends on the collective factor namely socio-economic conditions.

III. DATA MINING PROCESS

In this study, data gathered from different degree colleges and institutions affiliated with Dr. R. M. L. Awadh University, Faizabad, India. These data are analyzed using classification method to predict the student's performance. In order to apply this technique following steps are performed in sequence:

A. Data Preparations

The data set used in this study was obtained from different colleges on the sampling method of computer Applications department of course BCA (Bachelor of Computer Applications) of session 2009-10. Initially size of the data is 300. In this step data stored in different tables was joined in a single table after joining process errors were removed.

B. Data selection and transformation

In this step only those fields were selected which were required for data mining. A few derived variables were selected. While some of the information for the variables was extracted from the database. All the predictor and response variables which were derived from the database are given in Table 1 for reference.

Table 1: Student Related Variables

Variable	Description	Possible Values
Sex	Students Sex	{Male, Female}
Cat	Students category	{General, OBC, SC, ST}
Med	Medium of Teaching	{Hindi, English, Mix}
SFH	Students food habit	{veg , non-veg}
SOH	Students other habit	{drinking, smoking, both, not-applicable}
LLoc	Living Location	{Village, Town, Tahseel, District}
Hos	Student live in hostel or not	{Yes, No}
FSize	student's family size	{1, 2, 3, >3}
FStat	Students family status	{Joint, Individual}
FAIn	Family annual income status	{BPL, poor, medium, high}
GSS	Students grade in Senior Secondary education	{O – 90% -100%, A – 80% - 89%, B – 70% - 79%, C – 60% - 69%, D – 50% - 59%, E – 40% - 49%, F - < 40%}
TColl	Students College Type	{Female, Co-education}
FQual	Fathers qualification	{no-education, elementary, secondary, graduate, post-graduate, doctorate, not-applicable}
MQual	Mother's Qualification	{no-education,

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

		elementary, secondary, graduate, post-graduate, doctorate, not-applicable}
FOcc	Father's Occupation	{Service, retired, not-applicable}
MOcc	Mother's Occupation	{House-wife, Service, retired, not-applicable}
GObt	Grade obtained in BCA	{First > 60% Second >45 & <60% Third >36 & <45% Fail < 36%}

The domain values for some of the variables were defined for the present investigation as follows:

- **Cat –** From ancient time Indians are divided in many categories. These factors play a direct and indirect role in the daily lives including the education of young people. Admission process in India also includes different percentage of seats reserved for different categories. In terms of social status, the Indian population is grouped into four categories: General, Other Backward Class (OBC), Scheduled Castes (SC) and Scheduled Tribes (ST). Possible values are *General, OBC, SC and ST.*

- **Med –** This paper study covers only the degree colleges and institutions of Uttar Pradesh state of India. Here, medium of instructions are *Hindi* or *English* or *Mix* (Both Hindi and English).

- **SOH –** In modern society bad habits are increasing fast among college students. Here students other habit include *Drinking, Smoking, Both* or *Not-applicable*.

- **FSize-**. According to population statistics of India, the average number of children in a family is 3.1. Therefore, the maximum family size is fixed as 10 and possible range of values is from *one* to *ten.*

- **GSS -** Students grade in Senior Secondary education. Students who are in state board appear for five subjects each carry 100 marks. Grade are assigned to all students using following mapping *O – 90% to 100%, A – 80% - 89%, B – 70% - 79%, C – 60% - 69%, D – 50% - 59%, E – 40% - 49%,* and *F - < 40%*}.

- **GObt -** Marks/Grade obtained in BCA course and it is declared as response variable. It is also split into five class values: First – *>60% , Second – >45% and <60%, Third – >36% and < 45%, Fail < 40%.*

C. Implementation of Mining Model

Various algorithms and techniques like Classification, Clustering, Regression, Artificial Intelligence, Neural Networks, Association Rules, Decision Trees, Genetic Algorithm, Nearest Neighbor method etc., are used for knowledge discovery from databases.

Classification is one of the most frequently studied problems by data mining and machine learning (ML) researchers. It consists of predicting the value of a (categorical) attribute (the class) based on the values of other attributes (the predicting attributes). There are different classification methods. In the present study we use the Bayesian Classification algorithm.

Bayes classification has been proposed that is based on Bayes rule of conditional probability. Bayes rule is a technique to estimate the likelihood of a property given the set of data as evidence or input Bayes rule or Bayes theorem is-

$$P(h_i \mid x_i) = \frac{P(x_i \mid h_i)P(h_i)}{P(x_i \mid h_i) + P(x_i \mid h_2)P(h_2)}$$

The approach is called "naïve" because it assumes the independence between the various attribute values. Naïve Bayes classification can be viewed as both a descriptive and a predictive type of algorithm. The probabilities are descriptive and are then used to predict the class membership for a target tuple. The naïve Bayes approach has several advantages: it is easy to use; unlike other classification approaches only one scan of the training data is required; easily handle mining value by simply omitting that probability [11]. An advantage of the naive Bayes classifier is that it requires a small amount of training data to estimate the parameters (means and variances of the variables) necessary for classification. Because independent variables are assumed, only the variances of the variables for each class need to be determined and not the entire covariance matrix. In spite of their naive design and apparently over-simplified assumptions, naive Bayes classifiers have worked quite well in many complex real-world situations.

For the present study, we selected five degree colleges running BCA course affiliated with Dr. R. M. L. Awadh University, Faizabad, UP, India. Out of five degree colleges two was an urban-based, unaided and co-educational school, the other one was a rural-based, aided and female college and the other two was rural-based, aided and co-education college. A total of 300 (226 males, 74 females) students of BCA course from these five colleges who appeared in 2010 examination were the samples for our study. All the information related to student's demographic, academic and socio-economic variables was obtained from the 300 students directly through questionnaire and University database. The mark obtained of

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

these students was collected from the University Examination cell.

Given a training set the naïve Bayes algorithm first estimates the prior probability P (C_j) for each class by counting how often each class occurs in the training data. For ach attribute value x_i can be counted to determine P (x_i). Similarly the probability P (x_i | Cj) can be estimated by counting how often each value occurs in the class in the training data.

When classifying a target tuple, the conditional and prior probabilities generated from the training set are used to make the prediction. Then estimate P (t_i | C_j) by

$$P(t_i \mid c_j) = \prod_{k=1}^{p} (x_{ij} \mid c_j)$$

To calculate P (t_i) we can estimate the likelihood that t_i is in each class. The probability that t_i is in a class is the product of the conditional probabilities for each attribute value. The class with the highest probability is the one chosen for the tuple [10].

The present investigation used data mining as a tool with naïve Bayes classification algorithm as a technique to design the student performance prediction model. Filtered feature selection technique was used to select the best subset of variables on the basis of the values of probabilities.

D. *Result and Discussion*

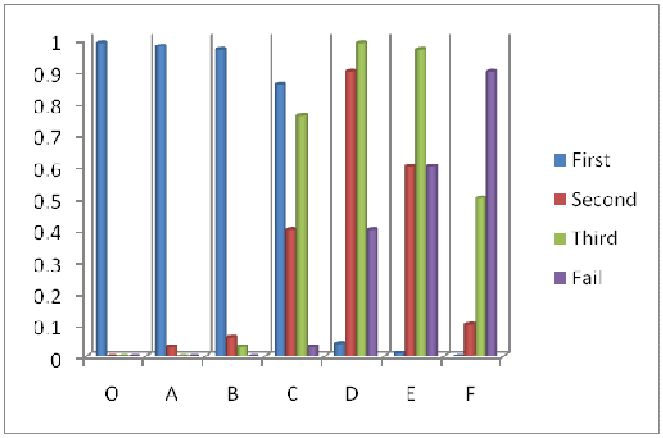
In the present study, those variables whose probability values were greater than 0.50 were given due considerations and the highly influencing variables with high probability values have been shown in Table 2. These features were used for prediction model construction. For both variable selection and prediction model construction, we have used MatLab.

Table 2: High Potential Variables

Variable	Description	Probability
GSS	Students grade in Senior Secondary education	.8642
LLoc	Living Location	.7862
Med	Medium of Teaching	.7225
MQual	Mother's Qualification	.6788
SOH	Students other habit	.6653
FAIn	Family annual income status	.5672
FStat	Students family status	.5225

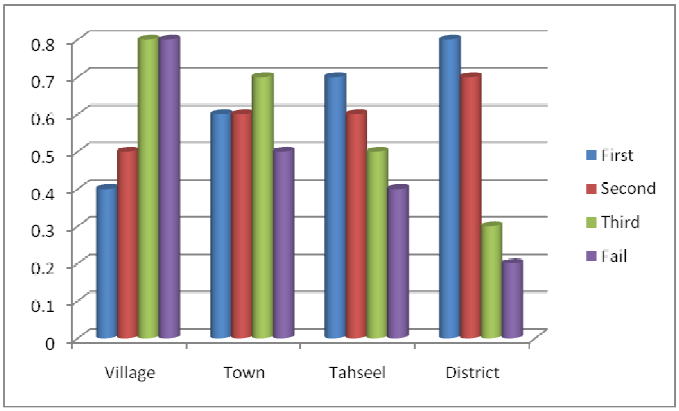
From the table 2, it is found that the students' performance is highly dependent on their grade obtained in Senior Secondary Examination, which is shown in Fig 1.

Figure 1: Relationship between GSS and GObt



From the table 2, it is found that the second high potential variable for students' performance is their living location. The relationship between students living area and their grade obtained in BCA examination is shown in Fig 2.

Figure 2: Relationship between LLoc and GObt

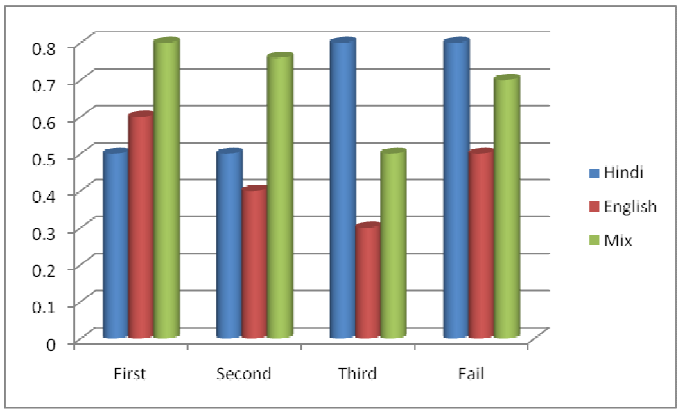


From the table 2, it is found that the third high potential variable for students' performance is medium of teaching. In Uttar Pradesh the mother tong language of students if Hindi. In Mixed and Hindi language students are more comfortable than English language. The relationship between students' medium of teaching and their grade obtained in BCA examination is shown in Fig 3.

Similarly, from table 2, it is found that Mother's Qualification, Students Other Habit, Family annual income and students' family status are other high potential variables that effect students' performance for obtaining higher grade in final examination.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Figure 3: Relationship between LLoc and GObt



IV Conclusion

In this paper, Bayesian classification method is used on student database to predict the students division on the basis of previous year database. This study will help to the students and the teachers to improve the division of the student. This study will also work to identify those students which needed special attention to reduce failing ration and taking appropriate action at right time.

Present study shows that academic performances of the students are not always depending on their own effort. Our investigation shows that other factors have got significant influence over students' performance. This proposal will improve the insights over existing methods.

REFERENCES

[1] AI-Radaideh,Q. A., AI-Shawakfa, E.M., and AI-Najjar, M. I., "Mining Student Data using Decision Trees", International Arab Conference on Information Technology(ACIT'2006), Yarmouk University, Jordan, 2006.

[2] Alaa el-Halees, "Mining Students Data to Analyze e-Learning Behavior: A Case Study", 2009.

[3] Bray, M. The Shadow Education System: Private Tutoring And Its Implications For Planners, (2nd ed.), UNESCO, PARIS, France, 2007.

[4] David Hand, Heikki, Mannil Padraic smyth, "Principles of Data Mining" PHI

[5] Galit.et.al, "Examining online learning processes based on log files analysis: a case study". Research, Reflection and Innovations in Integrating ICT in Education 2007.

[6] Han,J. and Kamber, M., "Data Mining: Concepts and Techniques", 2nd edition. The Morgan Kaufmann Series in Data Management Systems, Jim Gray, Series Editor, 2006.

[7] Hijazi, S. T., and Naqvi, R.S.M.M., "Factors Affecting Student's Performance: A Case of Private Colleges", Bangladesh e-Journal of Sociology, Vol. 3, No. 1, 2006.

[8] Khan, Z. N., "Scholastic Achievement of Higher Secondary Students in Science Stream", Journal of Social Sciences, Vol. 1, No. 2, 2005, pp. 84-87.

[9] Margret H. Dunham, "Data Mining: Introductory and advance topic".

[10] Pandey, U. K. and Pal, S., "Data Mining: A prediction of performer or underperformer using classification", (IJCSIT) International Journal of Computer Science and Information Technology, Vol. 2(2), 2011, 686-690, ISSN:0975-9646.

[11] Pandey, U. K. and Pal, S., "A Data Mining View on Class Room Teaching Language", (IJCSI) International Journal of Computer Science Issue, Vol. 8, Issue 2, March -2011, 277-282, ISSN:1694-0814

[12] Westphal, C., Blaxton, T., "Data Mining Solutions", John Wiley, 2008.

Author Profile

Brijesh Kumar Bhardwaj is Assistant Professor in the Department of Computer Applications, Dr. R. M. L. Avadh University Faizabad India. He obtained his M.C.A degree from Dr. R. M. L. Avadh University Faizabad (2003) and M.Phil. in Computer Applications from Vinayaka mission University, Tamilnadu. He is currently doing research in Data Mining and Knowledge Discovery.

Saurabh Pal received his M.Sc. (Computer Science) from Allahabad University, UP, India (1996) and obtained his Ph.D. in Mathematics from the Dr. R. M. L. Awadh University, Faizabad (2002). He then joined the Dept. of Computer Application, VBS Purvanchal University, Jaunpur as Lecturer. At present, he is working as Sr. Lecturer of Computer Applications. Saurabh Pal has authored a commendable number of research papers in international/national Conference/journals and also guides research scholars in Computer Science/Applications. His research interests include Image Processing, Data Mining and Grid Computing.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

ASIP Design Space Exploration: Survey and Issues

Deepak Gour
Assistant Professor – Dept. of CSE
Sir Padampat Singhania University
Udaipur, India
deepak.gour@spsu.ac.in

Dr. M. K. Jain
Assistant Professor – Dept. of CS
Mohan Lal Sukhadia University
Udaipur, India
manoj@cse.iitd.ernet.in

***Abstract*— An Application Specific Instruction set Processor (ASIP) is a processor designed for a particular application or for a set of applications. An ASIP exploits special characteristics of application(s) to meet the desired performance, cost and power requirements. The main steps involved in ASIP Design Methodology include application analysis, design space exploration, instruction set generation, code synthesis and hardware synthesis. This paper is an attempt to survey the design space exploration of ASIP. Important contributions made by various researchers are also highlighted. A list of explored design space parameters is included in this paper.**

Keywords- Application Specific Instruction set Processor (ASIP), Design Space Exploration (DSE), Performance estimation, Simulator based approach.

I. INTRODUCTION

An Application Specific Instruction set Processor (ASIP) is a processor designed for a particular application or for a set of applications. An ASIP exploits special characteristics of application(s) to meet the desired performance, cost and power requirements. According to Liem et al [1], ASIPs are a balance between two extremes: ASICs (Application Specific Integrated Circuit) and GPP (General Programmable Processors). Since an ASIC is specially designed for one behavior, it is difficult to make any changes at a later stage. In such a situation, the ASIPs offer the required flexibility at lower cost than GPP.

ASIP can be easily used in many embedded systems such as automotive control, household appliances, cellular phones, avionics etc. GPP are designed for general use. Many times it happens that specific applications need a certain mix which does not match the GPP resource mix. If we plan to design an ASIC to meet the given performance, power and area constraints for the given application, deign becomes rigid. In the ASIP design, it is important to search for a processor architecture that matches target application. To achieve this goal, it is essential to estimate design quality of various candidate architecture in terms of area, performance, and power consumption. Table 1 shows the comparison among GPP, ASIP and ASIC.

	GPP	ASIP	ASIC
Performance	Low	High	Very High
Flexibility	Excellent	Good	Poor
HW design effort	Nil	Large	Very Large
SW design effort	Small	Large	Nil
Power	Large	Medium	Small
Reuse	Excellent	Good	Poor
Markets	Very large	Relatively large	Small

TABLE I. COMPARISON AMONG GPP, ASIP AND ASIC

II. RELATED WORK

This section highlights the major work carried out in the ASIP design space explorations. The main contributors are Gloria et al [2] who defined some major requirements of the design of application specific architectures. Liem et al [1] described the differentiation between the ASIC, ASIP and GPP. MK Jain et al [3, 4, 5, 6, 7] had surveyed ASIP design methodologies and identified various steps involved in it. Since this survey was published in early 2001 and significant contributions are made by various researchers in due course of time. Sato et al [8] has developed an application program analyzer which is very useful in the application analysis. The methodology suggested by Gupta et al [9] takes the application as well as the processor architecture as inputs. Using SUIF [10] as an intermediate format a number of application parameter is extracted.

Apart from that Swarnalatha Radhakrishnan et al [11] explores the DSE on heterogeneous multiple pipelines. Ascia et al [12] explores the DSE using genetic algorithms on parameterized SOC platforms. Kwon et al [13] explores cache misses and memory architecture issues. Lilian Gogniat et al [14] explores DSE using special tool called Design Trotter. Kyeong et al [15] explore the DSE on issues related to Bus Architecture. Kim et al [16] explores the DSE on the issues of Area, Critical path delays. Kunzil et al [17] explores the DSE on the issues like # of cache lines, block size and replacement strategy. Catania et al [18] explores the DSE on the issues related on Register File size (GPR, FPR, PR, CR, BTR) and L1 and L2 caches. Pasricha et al [19] explores the DSE on the issues related to the Bus architecture.

III. ASIP DESIGN METHODOLOGY

Gloria et al [2] defined some main requirements of the design of application-specific architectures. Important among these are as follows:

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

- Design starts with the application behavior.
- Evaluate several architectural options.
- Identify hardware functionalities to speed up the application.
- Introduce hardware resources for frequently used operations only if it can be supported during compilation.

ASIP fits in between these two and provides flexibility at lower cost than general programmable processors. According to MK Jain et al [3, 4, 5, 6, 7] design of ASIP can be typically divided in five steps which is shown in Figure 1:

- Application Analysis
- Architecture design space Exploration.
- Instruction-set generation
- Code synthesis
- Hardware synthesis

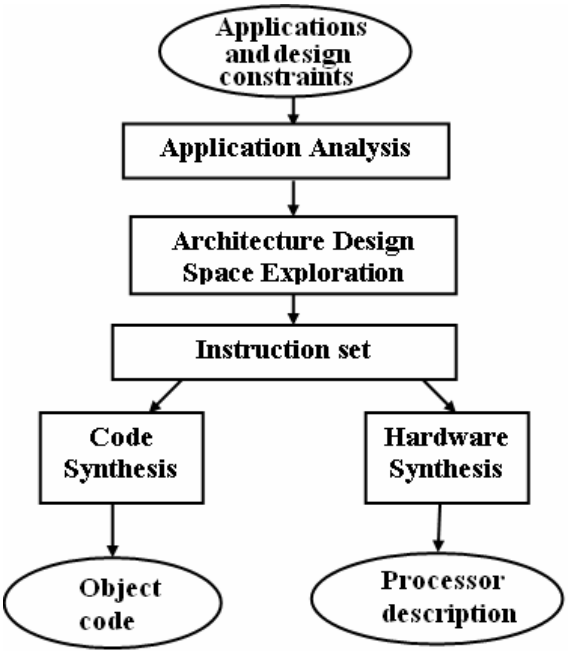


Figure 1. Flow Diagram of ASIP design Methodology

A. Application Analysis

ASIP design starts with analysis of application, analysis of test-data and design constraints. An application written in any high level language is analyzed both statically and dynamically which is then stored in some suitable intermediate format, which is then used in the subsequent steps.

B. Architecture Design Space Exploration

It involves identifying the broad architectural features of the ASIP. First of all, the architectural space to be explored is defined, keeping in view the parameters extracted during application analysis and the input constraints. Architecture is defined using some standard Architecture Definition Language (ADL) as EXPRESSION [20] and LISA [21, 22, 23].

C. Instruction Set Generation

Instruction set is to be generated for that particular application and for the architecture selected. This instruction set is used during the code synthesis and hardware synthesis steps.

D. Code Synthesis

Compiler generator or retargetable code generator is used to synthesize code for the particular application or for a set of application.

E. Hardware Synthesis

In this step the hardware is synthesized using the ASIP architecture template and instruction set architecture starting from a description in VHDL/VERILOG using standard tools.

IV. DESIGN SPACE EXPLORATION

Architecture exploration starts with the application analysis. We need to input the parameters of application analysis along with the identified architecture design space to the process block which is responsible for performance estimation. Then we need to do the performance estimation for the inputted architecture along with the search control and then the architecture will be selected. Figure 2 explains the procedure of architecture explorer.

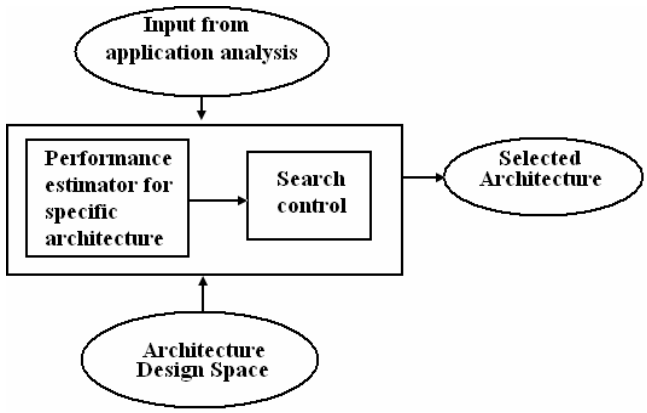


Figure 2. Block Diagram of an Architecture Explorer

Performance estimation which drives the design space exploration is done by simulator based approach (e.g. Gloria et al [2], Kienhuis et al [24], Imai , Binh et al [25]). The architectural design space is to be explored usually defined in terms of a parameterized architectural model.

The main focus points are as follows:

- The parameterized architectural model suggested by all the researchers includes the number of functional units of different types.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

- Architectures considered are different researchers also differing in terms of the instruction level parallelism they support.
- Most of these approaches consider only flat memory.

The most popular approach for ASIP design space exploration is simulator based approach. In the simulator based approach, a simulation model of architecture based on the selected features is generated and the application is simulated on this model to compute the performance. Figure 3 explains the functioning of simulator based approach.

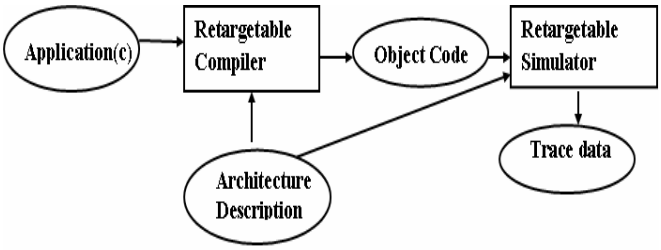


Figure 3. Architecture exploring using simulator based approach

V. PARAMETERS EXPLORED IN DESIGN SPACE EXPLORATION

In the recent past the major work carried out in Design Space Exploration is by using Simulator based approach. The major contributions are as follows:

Swarnalatha Radhakrishnan et al [11] explores the DSE on heterogeneous multiple pipelines. She proposed Application Speci_c Instruction Set Processors with heterogeneous multiple pipelines to efficiently exploit the available parallelism at instruction level. We have developed a design system based on the Thumb processor architecture. Given an application specified in C language, the design system can generate a processor with a number of pipelines specifically suitable to the application, and the parallel code associated with the processor. Each pipeline in such a processor is customized, and implements its own special instruction set so that the instructions can be executed in parallel with low hardware overhead.

Ascia, Vincenz Catania, Palesi et al [12] explores the DSE using genetic algorithms on parameterized SOC platforms. The basic idea is to avoid designing a chip from scratch. They proposed an approach based on genetic algorithms for exploring the design space of parameterized system-on-a-chip (SOC) platforms. The strategy focuses on exploration of the architectural parameters of the processor, memory subsystem and bus, making up the hardware kernel of a parameterized SOC platform for the design of embedded systems with strict power consumption and performance constraints. The approach has been validated on two different parameterized architectures: one based on a RISC processor and another based on a parameterized very long instruction word architecture.

Kwon, Lee, Kim, Ha et al [13] explores cache misses and memory arschitecture issues using Y-Chart approach to DSE. Y chart consists of two loops as 1) Co-synthesis loop for component selection and mapping of the function blocks to the processing components and 2) Communication DSE loop for communication architecture optimization.

Lilian Gogniat, Phillipe et al [14] explores DSE using special tool called Design Trotter. This tool allow for the exploration of their design space to choose the best architecture characteristics. They proposed an original approach based on a high-level representation of the application and on a hierarchical functional model for the architecture. This approach targets fine-grain, coarse-grain, and heterogeneous architectures.

Kyeong, Mooney et al [15] explore the DSE on issues related to Bus Architecture where they propose Bus Synthesis tool to generate the five different bus systems. This paper presents a methodology to generate a custom bus system for a multiprocessor System-on-a-Chip (SoC). Our bus synthesis tool (BusSyn) uses this methodology to generate five different bus systems as examples: Bi-FIFO Bus Architecture (BFBA), Global Bus Architecture Version I (GBAVI), Global Bus Architecture Version III (GBAVIII), Hybrid bus architecture (Hybrid) and Split Bus Architecture (SplitBA). They verified and evaluate the performance of each bus system in the context of two applications: an Orthogonal Frequency Division Multiplexing (OFDM) wireless transmitter and an MPEG2 decoder. This methodology gives the designer a great benefit in fast design space exploration of bus architectures across a variety of performance impacting factors such as bus types, processor types and software programming style.

Kim, Keimh, Choi et al [16] explores the DSE on the issues of Area, Critical path delays. The optimization is based on pipelining and sharing of functional resources in the PE of the array. They proposed efficient design space exploration flow with two optimization techniques. The optimization is based on pipelining and sharing of functional resources in the processing elements of the array. For fast architecture exploration, optimization techniques are applied to SystemC model. They estimated entire performance at early stage by transaction level simulation and this feature enables early detection of optimal architecture specification. With proposed design space exploration, one can effectively reduced the hardware cost without any performance degradation for a specific application domain.

Kunzil, Thiele et al [17] explores the DSE on the issues like # of cache lines, block size and replacement strategy. A generic approach is described based on multi-objective decision making, black-box optimization and randomized search strategies. The interface between problem-specific and generic parts of the exploration framework is made explicit by defining an interface called PISA. This specification and implementation interface, and the availability of a wide range of randomized multi-objective search methods, makes the proposed framework accessible to a wide range of exploration problems. It resolves the problem that existing optimization methods cannot be coupled easily to the problem specific part of a design exploration tool.

Ascia, Catania et al [18] explores the DSE on the issues related on Register File size (GPR, FPR, PR, CR, BTR) and L1

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

and L2 caches. They presented EPIC-Explorer, a framework for the simulation of a parameterized SOC platform based on a VLIW processor. The main use the platform has been designed for is to provide a powerful, flexible simulation and estimation framework that can be used to develop design space exploration algorithms. The high degree of parameterization of the platform generates an enormous configuration space, exhaustive exploration of which would be computationally unfeasible, and so it is an excellent testbed for comparison between different design space exploration algorithms.

Pasricha, Dutta et al [19] explores the DSE on the issues related to the Bus architecture. They proposed an automated application specific co-synthesis framework for memory and communication architectures (COSMECA) in MPSoC designs. The primary objective is to design a communication architecture having the least number of busses, which satisfies performance and memory area constraints, while the secondary objective is to reduce the memory area cost.

Table 2 list down the parameters explored using simulator based approach.

Sr. No.	Explored Design Space Exploration Parameters using Simulator based approach
1	Instruction cache size [Kunzil, Thiele et al [17]]
2	Data cache size [Kunzil, Thiele et al [17]]
3	Processor to address bus encoding [Pasricha, Dutta et al [19]]
4	Processor to data bus width [Pasricha, Dutta et al [19]]
5	Processor to data bus encoding [Pasricha, Dutta et al [19]]
6	Processor to address bus width [Pasricha, Dutta et al [19]]
7	Cache to memory address bus width [Pasricha, Dutta et al [19]]
8	Cache to memory address bus encoding [Pasricha, Dutta et al [19]]
9	Cache to memory data bus width [Pasricha, Dutta et al [19]]
10	Cache to memory data bus encoding [Pasricha, Dutta et al [19]]
11	GPR (General Purpose Register) File size [Ascia, Catania et al [18]]
12	FPR (Floating Point Register) File size [Ascia, Catania et al [18]]
13	PR (Predicate Register) File size [Ascia, Catania et al [18]]
14	CR (Control Register) File size [Ascia, Catania et al [18]]
15	BR (Branch Register) File size [Ascia, Catania et al [18]]
16	# of IU (Integer Units) [Kim, Keimh, Choi et al [16]]
17	# of FPU (Floating Point Units) [Kim, Keimh, Choi et al [16]]
18	# of MU (Memory Units) [Kim, Keimh, Choi et al [16]]
19	# of cache lines [Kunzil, Thiele et al [17]]
20	Block size [Kunzil, Thiele et al [17]]
21	Associativity [Kunzil, Thiele et al [17]]
22	Replacement strategy (LRU / FIFO) [Kunzil, Thiele et al [17]]
23	Bus speed [Kunzil, Thiele et al [15]]
24	Arbitration Speed [Kunzil, Thiele et al [15]]
25	OO Buffer size [Kwon, Lee, Kim, Ha et al [13]]
26	Memory Mapping [Kwon, Lee, Kim, Ha et al [13]]
27	Pipelined function [Swarnalatha Radhakrishnan et al [11]]
28	Latency of functional units [Kim, Keimh, Choi et al [16]]
29	Number of operational slots [Kim, Keimh, Choi et al [16]]

TABLE II. PARAMETERS OF DESIGN SPACE EXPLORATION USING SIMULATOR BASED APPROACH

VI. CONCLUSION

In this paper, we have surveyed this art of new processor technology. This paper laid down all the issues related to the design space exploration in detail using the simulator based approach which is one of the popular approaches. Paper also highlighted the important contributions made by various researchers with the list of explored design space parameters.

This paper also list down two major issues of the design space exploration as the unexplored design space parameters and the inability to map the large design space using the simulator based approach. There is a strong need felt in this survey is to use some another approach rather than simulator based approach for the effective design space exploration.

VII. REFERENCES

[1] Liem, C.; May, T.; Paulin, P., "Instruction-set matching and selection for DSP and ASIP code generation.", In Proc. EURODAC-94, 28 Feb.-3 March 1994, pp. 31-37.

[2] Gloria A. D.; Faraboschi, P., "An evaluation system for application specific architectures.", In Proc. Micro-23, 27-29 Nov. 1990, pp. 80-89.

[3] M.K. Jain, M. Balakrishnan, and A. Kumar, "ASIP Design Methodologies: Survey and Issues", In Proceedings of the IEEE / ACM International Conference on VLSI Design. (VLSI 2001), pages 76–81, January 2001.

[4] M.K. Jain, L. Wehmeyer, S. Steinke, P. Marwedel, and M. Balakrishnan, "Evaluating Register File Size in ASIP Design", In Proceedings of the Ninth International Symposium on Hardware/ Software Co-design,(CODES 2001), pages 109–114, April 2001.

[5] Manoj Kumar Jain, M. Balakrishnan and Anshul Kumar, "An Efficient Technique for Exploring Register File Size in ASIP Design", In Proceedings of the Fifthth International Conference on Compilers, Architecture and Synthesis for Embedded Systems, (CASES 2002).

[6] Manoj Kumar Jain, Lars Wehmeyer, Peter Marwedel, M. Balakrishnan, "Register File Synthesis in ASIP Design", Technical Report #746, 07.12.2000, Lehrstuhl Informatik XII, University of Dortmund, Germany.

[7] Manoj Kumar Jain, M. Balakrishnan and Anshul Kumar, "Exploring Storage Organization in ASIP Synthesis", In Digital System Design, 2003. Proceedings. Euromicro Symposium on Volume , Issue , 1-6 Sept. 2003 Page(s): 120 – 127.

[8] J. Sato, M. Imai, T. Hakata, A. Y. Alomary, N. Hikichi,, An integrated design environment for application specific integrated processor, In Proc. ICCD-91, pages 414-417, October 1991.

[9] T. V. K. Gupta, P. Sharma, M. Balakrishnan, S. Malik,, Processor evaluation in an embedded systems design environment, In Proc. VLSI Design 2000, pages 98-103, January 2000.

[10] SUIF Homepage. http://suif.stanford.edu/

[11] Radhakrishnan Swarnalatha: "Customization of application specific heterogeneous multi pipeline processors", In Proc. EDAA 2006, pp. 746 – 751.

[12] Giuseppe Ascia, Vincenzo Catania, and Maurizio Palesi, "A GA-Based Design Space Exploration Framework for Parameterized System-On-A-Chip Platforms", In IEEE TRANSACTIONS ON EVOLUTIONARY COMPUTATION, VOL. 8, NO. 4, AUGUST 2004, pp. 329 – 346.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

[13] Seongnam Kwon, Choonseung Lee, Sungchan Kim, Youngmin Yi, Soonhoi Ha, "Fast Design Space Exploration Framework with an Efficient Performance Estimation Technique", In Embedded Systems for Real-Time Multimedia, 2004. ESTImedia 2004. 2nd Workshop on Volume , Issue , 6-7 Sept. 2004 Page(s): 27 – 32.

[14] Lilian Bossuet, Guy Gogniat, and Jean-Luc Philippe, "Communication-Oriented Design Space Exploration for Reconfigurable Architectures", In EURASIP Journal on Embedded Systems, Volume 2007, Article ID 23496, 20 pages.

[15] Kyeong Keol Ryu and Vincent J. Mooney III, "Automated Bus Design Space Exploration for Multiprocessor SoC", In Design, Automation and Test in Europe Conference and Exhibition, 2003 Volume , Issue , 2003 Page(s): 282 – 287.

[16] Yoonjin Kim, Mary Kiemb, Kiyoung Choi, "Efficient Design Space Exploration for Domain-Specific Optimization of Coarse-Grained Reconfigurable Architecture", In Design, Automation and Test in Europe, 2005. Proceedings Volume , Issue , 7-11 March 2005 Page(s): 12 - 17 Vol. 1.

[17] S. Kunzli, L. Thiele and E. Zitzler, "Modular design space exploration framework for embedded systems", In Computers and Digital Techniques, IEE Proceedings - Volume 152, Issue 2, Mar 2005 Page(s): 183 – 192.

[18] Giuseppe Ascia, Vincenzo Catania, Maurizio Palesi and David Patti "EPIC Explorer: A parameterized VLIW based Platform Framework for Design Space Exploration", In First workshop on Embedded Systems for Real time Multimedia (ESTIMedia), Newport Beach, California, USA, Oct. 3-4, 2003.

[19] Sudeep Pasricha and Nikil Dutt, "A Framework for Memory and Communication Architecture Co-synthesis in MPSoCs", In Computer-Aided Design of Integrated Circuits and Systems, IEEE Transactions on Volume 26, Issue 3, March 2007 Page(s):408 – 420.

[20] A. Halambi, P. Grun, A. Khare, V. Ganesh, N. Dutt, A. Nicolau, EXPRESSION: A Language for Architecture Exploration through Compiler/Simulator Retargetability, In Proceedings of the Design Automation and Test in Europe (DATE), pages 485–490, March 1999.

[21] S. Pees, V. Zivojnovic, H. Mey, LISA- Machine Description Language for Cycle Accurate Models of Programmable DSP Architectures, In Proceedings of the Design Automation Conference (DAC), pages 933–938, June 1999.

[22] A. Hoffmann, T. Kogel, A. Nohl, G. Braun, O. Schliebusch, O. Wahlen, A. Wieferink, H. Meyr, A Novel Methodology for the Design of Application-Specific Instruction-Set Processors (ASIPs) Using a Machine Description Language, In IEEE Transactions on Computer Added Design of Integrated Circuits and Systems, 20(11) pages 1338–1354, November 2001.

[23] O. Schliebusch, A. Hoffmann, A. Nohl, G. Braun, H. Meyr, Architecture Implementation Using the Machine Description Language LISA, In Proceedings of the IEEE / ACM International Conference on VLSI Design and ASP Design Automation Conference. (VLSI/ ASPDAC 2002), pages 239–244, January 2002.

[24] B. Kienhuis, E. Deprettere, K. Vissers, The Construction of a Retargetable simulator for an architecture template In Hardware/Software Codesign, 1998. (CODES/CASHE apos;98) Proceedings of the Sixth International Workshop on Volume, Issue, 15-18 pages 125 – 129, March 1998.

[25] N. N. Binh, M. Imai, A. Shiomi, A new HW/SW partitioning algorithm for synthesizing the highest performance pipelined ASIPs with multiple identical FUs, In Proc. DAC-96, pages 126-131, September 1996.

Deepak Gour, Assistant Professor – Dept. of Computer Science & Engineering, School of engineering, Sir Padampat Singhania University, Udaipur did his B.Sc. (Computer Science) in 1998 & Master in Computer Application (MCA) in 2001. Currently he is Perusing Ph.D. from Department of Computer Science, Mohan Lal Sukhadia University, Udaipur. His research area is in ASIP Design Space Exploration. His Area of Specialization is in Embedded Systems and his Research interest lies in Application Specific Instruction set Processor.

M.K. Jain received the M.Sc. degree from M.L. Sukhadia University, Udaipur, India, in 1989. He received M.Tech. Degree in Computer Applications and PhD in Computer Science & Engineering from IIT Delhi, India in 1993 and 2004 respectively. He is Assistant Professor in Computer Science at M.L. Sukhadia University Udaipur, India since 1993. His current research interests include application- specific-instruction- set processor design and embedded systems.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

POur-NIR: Modified Node Importance Representative for Clustering of Categorical Data

S.Viswanadha Raju
Professor in CSE,SIT
JNTUH,Hyderabad,
India

N.Sudhakar Reddy
Professor in CSE
SVCE, Tirupati
India

H.Venkateswara Reddy
Assoc. Prof. in CSE
VCE, Hyderabad
India

G.Sreenivasulu
Assoc.Prof,CSE
VCE,Hyderabad
India

C.NageswaraRaju
Lecturer&HOD of CS
SVDC,Kadapa
India

viswanadha_raju2004@yahoo.com

Abstract - The problem of evaluating node importance in clustering has been active research in present days and many methods have been developed. Most of the clustering algorithms deal with general similarity measures. However In real situation most of the cases data changes over time. But clustering this type of data not only decreases the quality of clusters but also disregards the expectation of users, when usually require recent clustering results. In this regard we proposed Our-NIR method that is better than Ming-Syan Chen proposed a method and it has proven with the help of results of node importance, which is related to calculate the node importance that is very useful in clustering of categorical data, still it has deficiency that is importance of data labeling and outlier detection. In this paper we modified Our-NIR method for evaluating of node importance by introducing the probability distribution which will be better than by comparing the results.

Keywords- clustering, NIR,Our-NIR, Categorical data and node.

I. INTRODUCTION

Extracting Knowledge from large amount of data is difficult which is known as data mining. Clustering is a collection of similar objects from a given data set and objects in different collection are dissimilar. Most of the algorithms developed for numerical data may be easy, but not in Categorical data [1, 2, 12, 13]. It is challenging in categorical domain, where the distance between data points is not defined. It is also not easy to find out the class label of unknown data point in categorical domain. Sampling techniques improve the speed of clustering and we consider the data points that are not sampled to allocate into proper clusters. The data which depends on time called time evolving data. For example, the buying preferences of customers may change with time, depending on the current day of the week, availability of alternatives, discounting rate etc. Since data evolve with time, the underlying clusters may also change based on time by the data drifting concept [11, 16]. The clustering time-evolving data in the numerical domain [1, 5, 6, 10] has been explored in the previous works, where as in categorical domain not that much. Still it is a challenging problem in the categorical domain.

As a result, our contribution in modifying the Our-NIR method which is proposed by us [17] utilizes any clustering algorithm to detect the drifting concepts. Our-NIR method is modified by help of probability distribution so that the name this method is referred as POur-NIR. We adopted sliding window technique and initial data (at time t=0) is used in initial clustering. These clusters are represented by using POur-NIR (Our-NIR with the probability), where each attribute value importance is measured. By this method we can find whether the data points in the next sliding window (current sliding window) belongs to appropriate clusters of last clustering results or they are outliers which is future direction. We call this clustering result as a temporal and compare with last clustering result to drift the data points or not. If the concept drift is not detected to update the POur-NIR otherwise dump attribute value based on importance and then reclustering using clustering techniques. However we are comparing the node importance values of various methods with POur-NIR this paper.

The rest of the paper is organized as follows. In section 2 discussed related work, in section 3 basic notations and Node representation provided, in section 4 POur-NIR method for node importance discussed and also contains results with comparison of Ming-Syan Chen method and Our-NIR method and finally concluded with section 5.

II. RELATED WORK

In this section, we discuss various clustering algorithms on categorical data with cluster

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

representatives and data labeling. We studied many data clustering algorithms with time evolving.Cluster representative is used to summarize and characterize the clustering result, which is not fully discussed in categorical domain unlike numerical domain.
In K-modes which is an extension of K-means algorithm in categorical domain a cluster is represented by 'mode' which is composed by the most frequent attribute value in each attribute domain in that cluster. Although this cluster representative is simple, only use one attribute value in each attribute domain to represent a cluster is questionable. It composed of the attribute values with high co-occurrence. In the statistical categorical clustering algorithms [3,4] such as COOLCAT and LIMBO, data points are grouped based on the statistics. In algorithm COOLCAT, data points are separated in such a way that the expected entropy of the whole arrangements is minimized. In algorithm LIMBO, the information bottleneck method is applied to minimize the information lost which resulted from summarizing data points into clusters. However, all of the above categorical clustering algorithms focus on performing clustering on the entire dataset and do not consider the time-evolving trends and also the clustering representatives in these algorithms are not clearly defined.

In this paper, first object of our method which is based on the idea of representing the clusters by the importance of the attribute values. This representation is more efficient than using the representative points.
After scanning the literature, it is clear that clustering categorical data is un touched many ties due to the complexity involved in it. A time-evolving categorical data is to be clustered within the due course hence clustering data can be viewed as follows: there are a series of categorical data points D is given, where each data point is a vector of q attribute values, i.e., $p_j=(p_j^1,p_j^2,...,p_j^q)$. And $A = \{A_1,A_2 ,..., A_q\}$, where A_a is the a^{th} categorical attribute, $1 \leq a \leq q$. The window size N is to be given so that the data set D is separated into several continuous subsets S^t, where the number of data points in each S^t is N. The superscript number t is the identification number of the sliding window and t is also called time stamp. Here in we consider the first *N data points of data set D* this makes the first data slide or the first *sliding window* S^0. Our intension is to cluster every data slide and relate the clusters of every data slide with previous clusters formed by the previous data slides. Several notations and representations are used in our work to ease the process of presentation:

III. NODE REPRESENTATION

For categorical or mixed data can have several representations. But in our work we can take two sorts of data representations. In first kind of representation every data point present in the sliding window or data slide is divided into distinct points in which every distinct point is considered as the new node and each node has two parts, in this name or the categorical value is placed in the pre-part of the node where as the post-part contains the numerical value of that data point or the node. For example: nodes with attribute name "COMPOSE" which is a categorical part and the number of occurrences in the document '24' is a numerical part. This node is represented as follows:

Node [COMPOSE: 24]

This representation eventually reduces the ambiguity that may prevail among the attributes, as many attributes may have same value. By introducing the categorical part into the node we eliminate the risk of confusion. There is another form of representation of the data in our work. In this second representation we use a data description file that describes the data attributes and with a transitive relation we recognize the data attribute. This is the simplification of the above mentioned representation the only difference is that categorical part is kept in another file. This may look like the numerical representation of the data at an instance, but the value that is used to represent an attribute may be a numerical, binary, or categorical. This eases the effort that is required. This representation is also useful for the importance of node in the data set used in our work.

IV. IMPORTANCE OF NODE: POur-NIR

The distribution of Node that is described in above section represents a cluster. As mentioned every *node* has attribute value, the same value is used to find the distribution of the data points. Hence the importance of the node plays a great role in finding clusters the importance of the *node* is evaluated with the following rules such as rule 1 , rule 2 and rule 3. Here we considered a symbolic representation for the i^{th} node in cluster i is $N_{[i, r]}$, The number of data points in cluster C_i is m_i , and k is number of clusters .

Rule1 (Positive Probability of node $N_{[i, r]}$): The probability of node (p_i)in the cluster can be calculated as follows:

$$p_i = \frac{|N[i,r]|}{\sum_{z=1}^{k}|N[z,r]|}$$

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Rule 2 (Negative Frequency of node $N_{[i, r]}$): The negative frequency of the node in the cluster is calculated based on the probability of node $N_{[i, r]}$.

$$q_j = 1 - \frac{|N[j,r]|}{\sum_{z=1}^{k} |N[z,r]|}$$

Rule 3 (node distribution function): the node distribution function value can be calculated by the product of Rule 1 and Rule 2.

$$d(N[r]) = p_I * \pi q_j,\ j \neq i$$

Rule 4 (Weighted Function): the importance of node $N_{[i, r]}$ can be calculated by the product of Rule 3 and frequency of node in i^{th} cluster.

$$w(c_i, N_{[i, r]}) = \frac{|N_{[i, r]}|}{m_i} * d(N_{[i, r]})$$

The weighting function is designed to measure the distribution of the node between clusters based on the information theorem [15].

The weighting function measures the entropy of the node between clusters. Suppose that there is a node that occurs in all clusters uniformly. The node that contains the maximum uncertainty provides less clustering characteristics. Therefore, this node should have a small weight. Moreover, the maximum entropy value of a node between clusters equals. Our-NIR minimized the computation time because of normalization is not required where as in Chan proposed method considered normalization and highest frequency node getting the zero importance that give impurity clustering. Highest frequency node may get the relative importance by proposed POur-NIR Method which will reduce the impurity.

The importance of the node $N_{[i, r]}$ in cluster c_i is measured by multiplying the rule1 and rule 2 i.e., the weighting function $w(c_i, N_{[i, r]})$. Note that the range of both the probability of $N_{[i, r]}$ being in c_i and the weighting function $w(c_i, N_{[i, r]})$ is [0, 1], implying that the range of the important value $w(c_i, N_{[i, r]})$ is also in [0, 1].

The new method is related to the idea of conceptual clustering [9], which creates a conceptual structure to represent a concept (cluster) during clustering. However, NIR only analyzes the conceptual structure and does not perform clustering, i.e., there is no objective function such as category utility (CU) [11] in conceptual clustering to lead the clustering procedure. In this aspect our method can provide in better manner for the clustering of data points on time based.

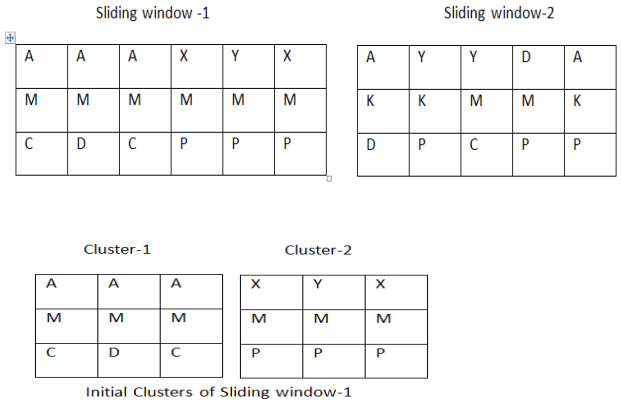


Fig 1. Sample data points of categorical data and initially cluster performed for the sliding window 1.

Example 1: consider the data set in fig 1.cluster c_1^1 contains three data points. The node {$[A_1=A]$} occurs three times in $c_1^1$and does not occurs in c_1^2.
The importance of node {$[A_1=A]$} in c_1^1 and in c_2^1 is calculated as follows the weight of the node $d(\{A_1=A\})$ = ((3/3)* (1-0/3)=1 and therefore an importance of the node $\{A_1=A\}$ in cluster c_1^1 is $w(c_1, \{A_1=A\})$ = (3/3)*1=1 and in cluster c_2^1 , it is zero. Similarly the remaining nodes as follows : Weight of the node $d(\{A_2=M\})$= ((3/6)*(1-3/6)=0.25 and therefore node importance in cluster c_1^1 is $w(c_1,\{A_2=M\})$=(3/3)*0.25=0.25 , weight of the node $d(\{A_3=C\})$= ((2/2)*(1-0/2)=1 and node importance in cluster in cluster c_1^1 is $w(c_1,\{A_3=C\})$=(2/3)*1=0.66, weight of the node $d(\{A_3=D\})$= ((1/1)*(1-0/1)=1 and node importance in cluster in cluster c_1^1 is $w(c_1,\{A_3=C\})$=(1/3)*1=0.33, similarly calculate the importance of the node values to the cluster c2,

Cluster C1

Node	CNIR	Our-NIR	POur-NIR
A1=A	1	0.5	1
A2=M	0	0.25	0.25
A3=C	0.66	0.33	0.66
A4=D	0.33	0.16	0.33

Cluster C2

Node	CNIR	Our-NIR	POur-NIR
A1=X	0.66	0.33	0.66
A2=Y	0.33	0.16	0.33
A3=M	0	0.25	0.25
A4=P	1	0.5	1

Fig 2. Node importance values for cluster C1 and C2

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

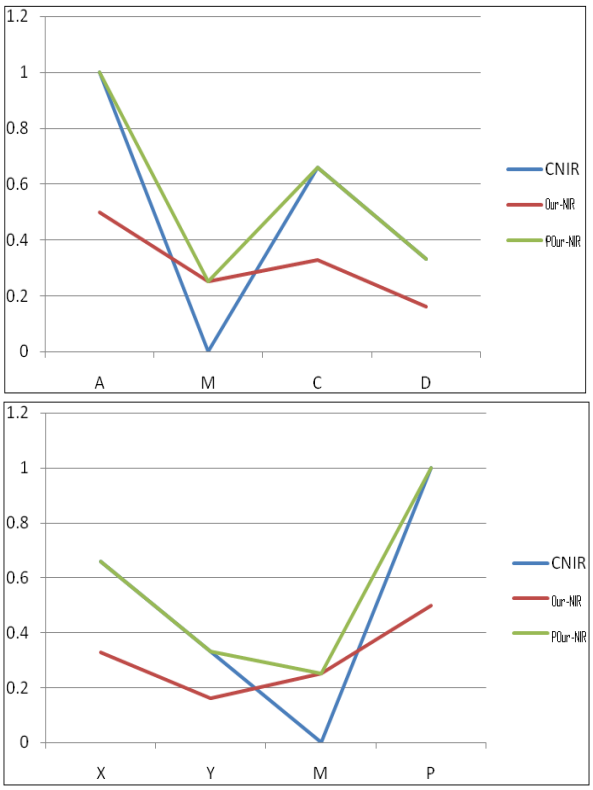


Fig 3 (a) NIR values of nodes for Cluster C1
Fig 3 (b) NIR Values of nodes for Cluster C2

A. Comparison of Our-NIR and POur-NIR

Fig 2 shows the importance value of attributes with size of window is 5. This study fixes for the two slides of data points with the time evolving that is from t1 to t2. As we said the importance of the node in that way we comparing the node importance values. The node importance values of our method is provide in a different way that increase the purity of the cluster which is impact on the accuracy of clustering. In figure 3 (a) and (b), we present the importance values of the each system maintained and over the 4 attributes of each cluster with sliding window size of given on importance of attributes of POur-NIR method is showing in range 0 to 1 and it has one major drawback that is if node occurs in both the clusters with highest frequency, even though it may get zero importance ,Our-NIR showing in the range 0.16 to 0.5 that means all the attributes might be getting more or less importance .POur-NIR Method showing the range 0.25 to 1 which is an average to the above methods so it can be better for the maintenance of the purity clustering.

V. CONCLUSION

In this paper, we considered the previous work that is Our-NIR Method which is modified by the Probability distribution that is to find node importance of node. We analyzed by taking same example in this find the differences in the node importance values of attributes in same cluster which plays an important role in clustering. The future work deciding the class label of unclustered data point and therefore the result demonstrates that POur-NIR method is accurate as said in section 4, than by our previous Method and also it improves the performance of precision and recall of DCD.

REFERENCES

[1] C. Aggarwal, J. Han, J. Wang, and P. Yu, "A Framework for Clustering Evolving Data Streams," *Proc. 29th Int'l Conf.Very Large Data Bases (VLDB)* ,2003.

[2] C.C. Aggarwal, J.L. Wolf, P.S. Yu, C. Procopiuc, and J.S. Park, "Fast Algorithms for Projected Clustering," *Proc. ACM SIGMOD '99,* pp. 61-72, 1999.

[3] P. Andritsos, P. Tsaparas, R.J. Miller, and K.C. Sevcik, "Limbo: Scalable Clustering of Categorical Data," *Proc. Ninth Int'l Conf. Extending Database Technology (EDBT),* 2004.

[4]D. Barbará, Y. Li, and J. Couto, "Coolcat: An Entropy-Based Algorithm for Categorical Clustering," *Proc. ACM Int'l Conf. Information and Knowledge Management (CIKM),* 2002.

[5] F. Cao, M. Ester, W. Qian, and A. Zhou, "Density-Based Clustering over an Evolving Data Stream with Noise," *Proc. Sixth SIAM Int'l Conf. Data Mining (SDM),* 2006.

[6] D. Chakrabarti, R. Kumar, and A. Tomkins, "Evolutionary Clustering," *Proc. ACM SIGKDD '06,* pp. 554-560, 2006.

[7] H.-L. Chen, K.-T. Chuang and M.-S. Chen, "Labeling Unclustered Categorical Data into Clusters Based on the Important Attribute Values," *Proc. Fifth IEEE Int'l Conf. Data Mining (ICDM),* 2005.

[8]H.-L. Chen, M.-S. Chen, and S-U Chen Lin "Frame work for clustering Concept –Drifting categorical data," *IEEE Transaction Knowledge and Data Engineering v21 no 5* , 2009.

[9] D.H. Fisher, "Knowledge Acquisition via Incremental Conceptual Clustering," Machine Learning, 1987.

[10]MM Gaber and PS Yu "Detection and Classification of Changes in Evolving Data Streams," *International .Journal .Information Technology and Decision Making,* v5 no 4, 2006.

[11] M.A. Gluck and J.E. Corter, "Information Uncertainty and the Utility of Categories," Proc. Seventh Ann. Conf. Cognitive Science Soc., pp. 283-287, 1985.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

[12]G Hulton and Spencer,"Mining Time-Changing Data Streams" *Proc. ACM SIGKDD,* 2001.
[13]AK Jain MN Murthy and P J Flyn "Data Clustering: A Review," *ACM Computing Survey,* 1999.
[14]O.Narsoui and C.Rojas,"Robust Clustering for Tracking Noisy Evolving Data Streams" *SIAM Int. Conference Data Mining ,* 2006.
[15]C.E. Shannon, "A Mathematical Theory of Communication," Bell System Technical J., 1948.
[16]S.Viswanadha Raju, H.Venkateswara Reddy andN.Sudhakar Reddy," A Threshold for clustering Concept – Drifting Categorical Data", IEEE Computer Society, ICMLC 2011.
[17]S.Viswanadha Raju, H.Venkateswara Reddy and N.Sudhakar Reddy," Our-NIR:Node Importance Representation of Clustering Categorical Data ", International Journal of Computer Science and Technology (Accepted) 2011.

Packet Forwarding Encouragement Scheme in a Wireless Sensor Network

Praveen Kaushik
Department of CSE
MANIT
Bhopal, India
praveenkaushikmanit@gmail.com

Jyoti Singhai
Department of ECE
MANIT
Bhopal, India
j.singhai@gmail.com

***Abstract*- The most common issue in wireless sensor networks is limited availability of energy within network nodes. A widely used energy-saving technique is to place nodes in sleep mode, corresponding to low-power consumption as well as to reduce operational capabilities. To conserve energy, sometime nodes may try to maximize the benefits of its own without participating in routing services (e.g. without forwarding packets of other nodes). To conquer with this problem, several schemes have been investigated in the literature. In this paper such nodes are detected and evicted from the network using rating based multipath dynamic source routing. In our approach after route discovery, multiple paths are returned by the destination node, which are stored by source node in route cache. Once source node identifies such node in its path based on its rating threshold, an alternative path is selected from the route cache. In sensor network a node may be overused due to network topology. In order to mitigate this problem, this paper uses a minimum battery cost routing (MBCR).The simulation results for rating based multipath dynamic source routing indicates significant improvement in aggregate network throughput.**

Keywords- minimum cost; multipath ; reluctant node; wireless sensor network;

I. INTRODUCTION

A Wireless Sensor Network (WSN) is a collection of low-end devices whose size can range from a few hundred sensors to a few hundred thousand or possibly more. The sensors do not rely on any pre-deployed network architecture. The power supply of each individual sensor is provided by a battery, whose consumption for both communication and computation activities must be optimized. A WSN may consist of many nodes without any grouping hierarchy. Nodes can communicate using any wireless technology such as Bluetooth, ZigBee or IEEE standards.

In wireless sensor networks, two nodes can exchange data when they are located within one another's communication range. In WSN all nodes cooperates and forward packet for each other as a router. Here it is possible that nodes may not be within the communication range of each other. At this stage, nodes extend the transmission range by multi hop packet forwarding. In ad hoc network nodes can be of two types' cooperative nodes and inactive nodes. Cooperative nodes comply with the standard at all times. Inactive nodes include lazy nodes and constrained nodes (e.g. energy constrained or field strength constrained). A routing algorithm plays a crucial role in transmission of data among nodes. Also dynamic behavior of nodes causes several challenges in design of routing scheme. A lot of algorithms have been proposed claiming fairness in routing. DSR is most widely adapted algorithm for routing. But the original algorithm is known to fail in a scenario containing non cooperative nodes. In [1] proposed a mechanism for identifying and isolating selfish nodes to attain fairness. However after decaling a node selfish, source node needs to identify alternate path using Route Discovery. This causes a lot many packet drops before it identifies alternate path.

Multipath Source Routing [10] can increase performance by providing applications the liberty to use multiple paths during packet forwarding. Also it stores multiple paths required. With Multipath Source Routing data can be forwarded on arbitrary routes, which makes it very easy to forward data to multiple paths without use of path using Route Discovery. This causes a lot many packet drops before it identifies alternate path.

II. NODE MODEL

A. *Malicious nodes*

Nodes which drops packet with the intention to cause network attack.

B. *Reluctant nodes*

Reluctant nodes try to save their own resources since resources are very constrained in wireless network. Reluctant nodes may decide to conserve their resources by not forwarding data packets for other nodes:

This can be achieved in two ways:

1) Reluctant node of type 1: In this model the reluctant node do not participate in the Route Discovery phase of DSR protocol[10] . Such reluctant nodes not only drop packets that have a source address or destination address different from these reluctant nodes but also drop all RREQ packet they receive or not forward RREP packet to some destination. If the node does not participate in the route discovery process, then there will be no route with that reluctant node. The outcome is that these reluctant nodes will be isolated i.e. these nodes will

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

never participate in packet forwarding. A reluctant node of this type uses the node energy only for its own communication.

2) Reluctant node of type 2: In this type of model, the reluctant node does not forward packets which are destined to other nodes[10]. These reluctant nodes participate correctly in the routing function by advertising available roots. When this behaviour is chosen, reluctant nodes do not cooperate in packet forwarding function. However, a reluctant node that operates complying with this model, participates in the route discovery and route maintenance phase of the DSR protocol. The outcome of this type of behaviour is that the reluctant node will save a major amount of energy (battery life) by dropping great no of data packets.

III. RELATED WORK

A lot of algorithm has been proposed claiming fairness in routing.L Wang, Y Shu, M Dong, L Zhang proposed a multipath source routing scheme [9]. This scheme makes use of DSR's route discovery mechanism whereby multiple routes can be returned. The more alternative routes available in route cache, the more possibility that a node can find a perfect route. To get multiple route dsr optional feature is enabled. All the routes discovered are stored in the route cache with a unique route index. Route index is used in selecting multiple paths from the route cache.

S. Marti, T. J. Giuli, K. Lai and M. Baker proposed two techniques that improve throughput of a network in the presence of reluctant nodes [1]. The watchdog method is used for each node to detect misbehaving nodes in the network. When a node sends a packet to next hop, it tries to overhear the packet forwarded by next hop. If it hears that the packet is forwarded by next hop and the packet matches the previous packet that it has sent itself, it considers the next hop node behaves well. Otherwise it considers the next hop node is misbehaving. The pathrater uses the knowledge about misbehaving nodes acquired from watchdog to pick the route that is most likely to be reliable. Each node maintains a trust rating for every other node. When watchdog detects a node is misbehaving, the trust rating of the node is updated in negative way. When a node wants to choose a safe route to send packets, pathrater calculates a path metric by averaging the node ratings in the path.

S. Marti, T. J. Giuli, K. Lai and M. Baker implemented the solutions on DSR protocol using ns2 as simulation environment. The simulation result shows the throughput of the network is increased by up to 27% in a network where packet drop attack happens. However, routing overhead is also increased up to 24%.

A lot of work has been proposed on sensor network using reputation to bring fairness in routing [11]. S. Buchegger and J.Y. LeBoudec proposed CONFIDANT algorithm using both direct and indirect observations to measure fairness in Dynamic Ad -hoc Networks [2]. CONFIDANT makes a distinction trust from reputation. For each node, reputation rating signifies how well a node behaves while trust rating stands for how honest a node is. Reputation rating is used to make a decision whether the node is regular or misbehaved, while trust rating is used to choose whether the node is trustworthy or not as a recommender.

Michiardi and Molva proposed CORE (Collaborative Reputation mechanism) [3]. It defers from Watchdog and CONFIDANT by bringing aging factor with more weight on past observations and isolating nodes having bad reputation. Three types of reputations are used in the CORE.

Subjective reputation of a target node is the reputation calculated directly from a subject's inspection of the target node's behavior. Indirect reputation is evaluated only considering the direct communication between a subject and its neighbours. Function reputation is the subjective and indirect reputation calculated with respect to different functions such as forwarding a data packet, reply route request. The final reputation information is combined from the three reputations with different weight associated to the functional reputation value. CORE consists of two basic components: Reputation Table (RT) is a data structure stored in each network entity, keeping the reputation data pertaining to the nodes in the network. The Watchdog mechanism (WD) is used to detect misbehaving nodes. With CORE only positive rating factors are distributed among the entities to avoid a misbehaving entity to distribute false information about other entities in order to initiate a denial of service (DoS) attack.

Miranda and Rodrigues classified nodes into friends, foes and reluctant but at the cost of memory and message overhead [4]. W. J. Adams, G. C. Hadjichristofi and N. J. Davis used Reputation Indexing Windows (RIW) to handle misbehaving nodes [5]. Unlike CORE it emphasised on current feedback items rather than old ones.

S. Zhong, J. Chen and R. Yang proposed Sprite [13], a credit-based system for MANET. As opposed to Nuglets or Counter they do not require tamper-proof hardware to prevent the fabrication of payment units.

IV. DYNAMIC SOURCE ROUTING

A. Overview

The DSR is an entirely on demand routing protocol which composed of two parts: route discovery and route maintenance [6].

B. Route Discovery

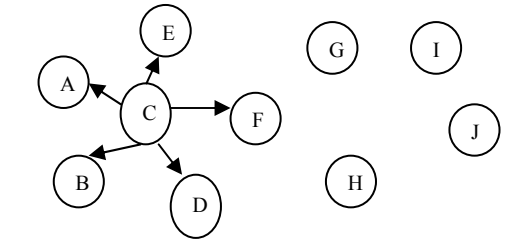
In DSR, whenever a node needs to send a packet to some destination for which, it does not currently have a route in its route cache, it initiates Route Discovery to find a route. The initiator broadcasts a Route Request packet to its neighbours, specifying the target and a unique identifier from the initiator. Each node receives the route request. If it has recently seen this request identifier from the initiator, discards the request. Otherwise it appends its own node address to a list in the request and rebroadcasts the request. When the route request reaches its target node, the target sends a route reply back to the initiator of the request, including a copy of accumulated list of address from the request. When the reply reaches the initiator of the request, it caches the new route in the route

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

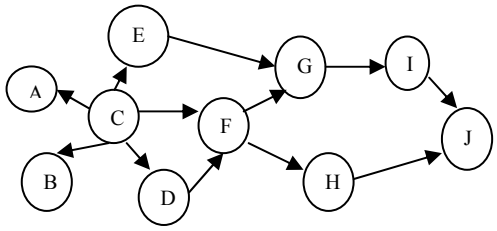
cache. The intermediate node also sends a route reply, if it has a route to the destination.

C. Route maintenance

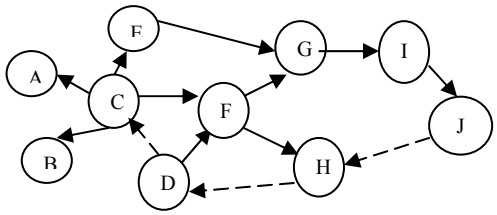
It is a mechanism by which a node sending a packet along a specified route to some destination detects if that route has broken. If after a limited no of local retransmission of the packet a node in the route is unable to make this confirmation, it returns a route error to the original source of the packet, identifying the link from itself to the next node as broken.



(a)



(b)



(c)

Figure 1.Example of Route Request: Node C is source node while Node J is destination. (a) Node C broadcasts a route request packet to find a path to node J. (b) Neighbour nodes broadcasts route request in the same manner but adding its own address to the packet. In the same manner route request is forwarded throughout the network. (c) J sends back a route reply to C using the path contained in one of the route request packet.

V. REPUTATION BASED MULTIPATH DYNAMIC SOURCE ROUTING

In this work we try to find a hybrid approach that reduces packet drops caused by identification and isolation of reluctant nodes using algorithm proposed by [9] with the help of multipath source routing. Reputation based multipath dynamic mechanism has two elements –

A. Multipath dynamic source routing

B. Efficient Packet forwarding and load balancing (Reputation based) Multipath Dynamic Source Routing

Multipath routing makes use of DSR's route discovery mechanism whereby multiple routes can be returned. With standard DSR, a node selects a shortest route to the destination from the route cache. In this mechanism, it works as the more alternative routes available in route cache, the more possibility that a node can find a perfect route. To get multiple route DSR optional features is enabled. All the routes discovered are stored in the route cache with a unique route index. Route index is used in selecting multiple paths from the route cache.

Efficient Packet forwarding and load balancing

Since this mechanism makes use of source routing intermediate nodes forwards the packet as the route indicated in packet's header. Reputation based packet forwarding to handle reluctant behaviour. The mechanism counts on the principle that a node freely evaluates its neighbours based on the completion of requested service. The core principle is that when a node forwards packet through one of its neighbours, it holds the neighbour responsible for the correct delivery of the packet to destination. Fig. 2 illustrates the operation of mechanism.

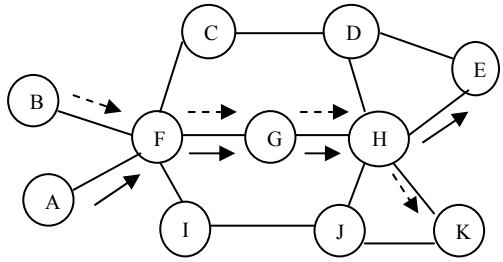
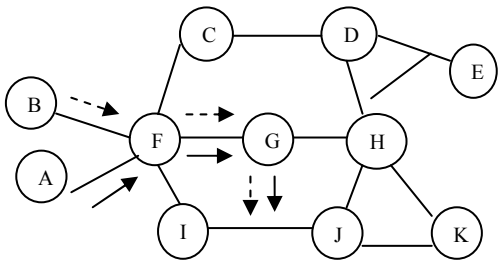


Figure 2.Sensor network with reluctant node G.

Consider two flows A-F-G-H-E, B-F-G-H-K, in fig.

1 Suppose node G starts acting reluctantly, dropping all the packets that it is likely to forward.
2 Once, neighbour nodes of G will notice that packets are not being delivered to their intended destinations.



http://sites.google.com/site/ijcsis/
ISSN 1947-5500

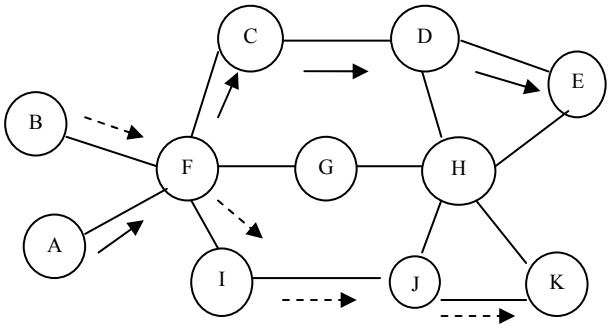


Figure 3.Reluctant node G dropping packets forwarded from node F

3 Node F will reduce the reputation index it assigns to G twice due to G's effect on both flows.
4 Immediate neighbours of node F and H will in turn reduce the reputation index; they give to node F and H.
5 Once G's reputation index goes below a certain threshold, a new path is selected from the route cache.

In a network of nodes N = {1,2,...,n}, each node i maintains a reputation table where a reputation index R_{ij} is stored for each of the node's immediate neighbours j. A node credits a reputation index to each of its neighbours based on successful delivery of packets forwarded through that neighbour. On the other hand delivery failures penalize such neighbours by decreasing the reputation index. Success or Failure is decided based on feedback obtained from the destination.

In this mechanism, each node maintains a lookup table to keep information about data packets forwarded through it. It stores source and destination IP, port number, sequence number and the next hop address. Each node also maintains a reputation table in which, a node stores two thing neighbour node id and its reputation. Following algorithm illustrates the operation of mechanism.

Load balancing

In order to perform load balancing this paper uses Minimum Battery Cost Routing [7] in MP-DSR where accumulated path cost is used. If length of path P is L then its accumulated path cost is:

$$C(P) = \sum_{i=1}^{i=L} C\{D_i, D_{i+1}\} \qquad (1)$$

Where, C {Di, Di+1} implies that the link cost in path P from Di to Di+1 for linkl .

To consume the energy in a more balance manner, an intuitive technique is to utilize cost function based on the node's remaining battery capacity. In Minimum Battery Cost Routing (MBCR) [8] the battery cost C for a particular route π with n nodes is defined as:

$$C_\pi = \sum_{i=1}^{i=n} \frac{1}{C_i} \qquad (2)$$

Ci is the remaining battery capacity of node. As the battery capacity decreases, the value of cost function for node n will increase. Therefore to find a route with maximum remaining battery capacity we should select a route π that has minimum battery cost

C π = min{Ci | i Є A} where A is the set containing all possible routes. Since battery capacity is directly incorporated into the routing protocol, this metric prevent hosts from being overused, thereby increasing their lifetime and the time until the network is partitioned

VI. ALGORITHM

1. During route discovery a source node sends a RREQ packet to its neighbouring nodes. RREQ message must contain source address, destination address, hop count, sequence no.
2. The intermediate nodes after appending their addresses again broadcast RREQ to the hop-2 neighbours. This process continues until RREQ get to the destination node.
3. Destination node sends a route reply back to the source node, including a copy of accumulated list of address from the RREQ.
4. When the reply reaches the initiator of the request, it caches the new route in the route cache. Here multiple paths are returned to source node. All the routes discovered are stored in the route cache with a unique route index. Route index is used in selecting multiple paths from the route cache. During data transfer, when a node receives a data packet, it checks if received packet is a retransmission. If data packet is a retransmission then node decrements the reputation index of the neighbour through which the original packet was forwarded.
5. If R_{ik} be the reputation index of previous hop k and rt_{hrash} be the reputation threshold then -
6. if ($R_{ik} < R_{thrash}$)
7. drop the packet
8. else
9. store related information and forward the packet
10. If a node receives acknowledgement packet, it increments the reputation of its neighbour node.
11. Once a node's reputation index goes below a certain threshold, a new path is selected from the route cache using MBCR (minimum battery cost routing.) and data is sent through new path.

VII. SIMULATION SETUP AND EVALUATION

Using ns-2[14] we study the performance of our mechanism. In our simulation we placed 20% nodes randomly in 670×670 area. Each node has a transmission range of 250m and moves at a speed of 10m/s. We randomly generate CBR (Constant

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Bit Rate) TCP flows. Neighbours identified as reluctant (i.e. whose reputation index is below threshold). All route requests (RREQs) and route replies forwarded by such neighbours will be ignored. Simulation parameters are shown in table I.

Table I. SIMULATION PARAMETER

Parameter	Value
Number of nodes	20
Routing scheme	DSR
Packet size	512 bytes
Traffic model	CBR
Propagation	Two Ray Ground
Max speed of nodes	15 ms
Initial energy of node	1000 joules
Simulation Time	200 sec

A. Simulation result

The impact of reluctant nodes was measured in terms of total number of packet dropped, number of packet received, packet delivery ratio and network throughput. The measurements of the network were made using a AWK script that parses and analyse the trace file output provided by ns-2 software. The trace file gives information about a ser of defined events which occurred in the simulation such as routing events and agent event. Through agent event trace not only it is possible to estimate the total no packet sent by every node of the MANET but also the total number of packets which have been dropped.

Aggregate Network throughput (AGT) is the ratio of total number of bits received to the total number of bits sent

AGT = Total number of received bits / Total number of sent bits

Packet delivery ratio (PDR) is the ratio of total number of packets sent the total number of packet received.

PDR = Total number of sent packets / Total number of received

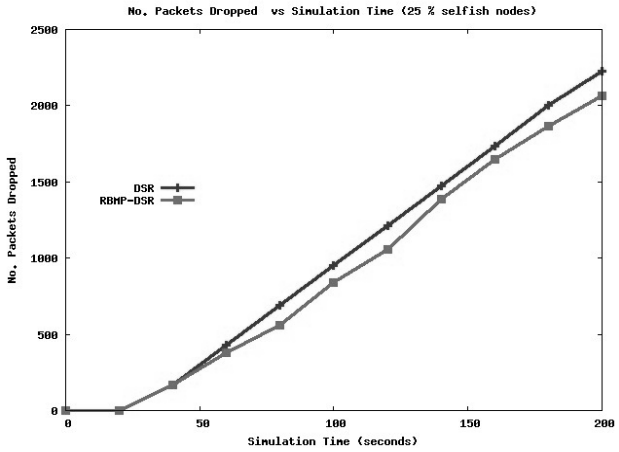


Figure 4.Total Number of packet drop in DSR vs. Number of packet dropped in reputation based multipath DSR

As shown in the above graph x axis indicates Simulation time and y axis indicates number of packets received. Red line indicates number of packet received vs. simulation time for original method. Blue line indicates number of packet received vs. simulation time. From the above graph it is observed that number of packet recieved in original method is notably less. In above graph initially for 10 seconds both lines are touching x axis because in the network traffic flow starts at 10 second.

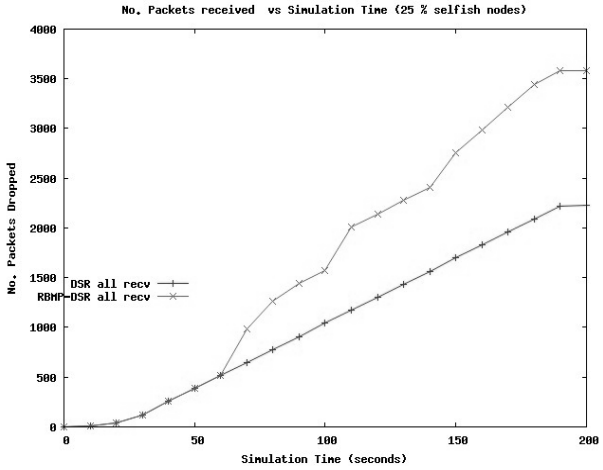


Figure 5.Total Number of packet received in original DSR vs. Number of packet received in reputation based multipath DSR.

Table II. AGGREGATE NETWORK THROUGPUT

Parameter	% reluctant nodes	DSR	RB-MPDSR
Aggregate network throughput	25	33.04	43.06

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

VIII. CONCLUSION AND FUTURE WORK

In wireless sensor network, due to limited energy of nodes, some nodes may do not participate in routing functions. This paper deals with detection and isolation of such nodes. The proposed method has certain limitations such as in proposed method cooperative nodes may be accused of reluctant behaviour on account of packet drop due to collision, memory overflow, energy. Currently we are working to mitigate these limitations.

REFERENCES

[1] S. Marti, T. J. Giuli, K. Lai and M. Baker "Mitigating routing misbehavior in mobile sensor networks," Proceedings of Sixth Annual IEEE/ACM Intl. Conference on Mobile Computing and Networking , April 2000,PP. 225-256.

[2] S. Buchegger and J.Y. LeBoudec, "Performance analysis of CONFIDENT protocol: cooperation of nodes – fairness in dynamic sensornetworks," Proceedings of the ACM MobiHoc, June 2002.

[3] P. Michiardi and R. Molva, "CORE: A collaborative reputation mechanism to enforce node cooperation in mobile sensor networks," Proceedings of the 6th Joint Working Conference on Communication and Multimedia Security , September 2002, pp. 107-121.

[4] H. Miranda and L. Rodrigues, "Friend and Foes: Preventing Reluctantness in open Mobile Sensor Networks," Proceedings of Intl. conf. Distributed Computing System Workshop 2003, pp. 440-445.

[5] W. J. Adams, G. C. Hadjichristofi and N. J. Davis, "Calculating a Node's Reputation in a Mobile Adhoc Network," In Proceedings of IEEE Intl. Performance Computing and Communications Conference (IPCCC)2005, pp. 303-307.

[6] D. Johnson , D. A. Maltz, and J. Broch. The Dynamic Source Routing Protocol for Mobile Sensor Networs (Internet-Draft). Mobile Ad-hoc Network (MANET) Working Group, IETF, October 1999.

[7] C. K. Toh, "Maximum Battery Life Routing", IEEE Communication Magazine, June, 2001.

[8] M. Tamer Rafaei, Vivek Srivastav, Luiz DaSilva, "A Reputation-based Mechanism for Isolating Reluctant Nodes in Adhoc Networks,"Proceedings of the Second Annual Internatinal Conference on Mobileand Ubiquitous Systems: Networking and Services(MobiQuitous'05).

[9] L Wang, Y Shu, M Dong, L Zhang, OWW Yang "Multipath Source Routing in Wireless Sensornetwork ," Proceedings of IEEE ICC'01, 2001.

[10] P. Michiardi and R. Molva, "Simulation based analysis of security exposures in mobile sensornetworks," Proceedings of the European Wireless Conference, February 2002.

[11] K.Mandalas, D.Flitzenis, G.F Marias and P Georgiadis, "A Survey of several cooperation schemes for MANETs," Proceedings of International Symposiam on Signal processing and Information Technology, 2005.

[12] Eliabeth M.Royer, Santa Barbara Chai-Keong Toh " A Review of Current Routing Protocols For SensorMobile Wireless Networks,"Proceedings of IEEE Personael Communications, April 1999.

[13] S. Zhong, J. Chen and R. Yang, "Sprite: A Simple, Cheat-proof, Creditbased System for Mobile Ad-hoc Networks", in Proc. IEEE INFOCOM2003, Apr. '03.

[14] "The ns Manual (formerly ns Notes and Documentation)", The VINT Project Collaboration between researchers at UC Berkeley, LBL, USC/ISI, and Xerox PARC, January 6 – 2010.http://www.isi.edu/nsnam/ns/doc/ns_doc.pdf.

AUTHORS PROFILE

Mr. Praveen Kaushik is Assistant Professor in Maulana Azad National Institute of Technology (MANIT) Bhopal, India. He is pursing PhD in WSN. His general research interests include WSNs, Ad hoc Network and Wireless Communication.

Dr. Jyoti Singhai is Associate professor in Maulana Azad National Institute of Technology (MANIT), Bhopal, India. She holds Ph..D degree from MANIT India. Her general research interests include wireless communication, image processing, WSN and network security.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

A Multi-Criteria Decision Model for EOL Computers in Reverse Logistics

K.ArunVasantha Geethan
Department of Mechanical Engineering
Sathyabama University, Chennai. India

Dr.S.Jose
Loyola-ICAM College of Engineering &
Technology ,Chennai. India

R.Devisree
Cognizant Technology Solutions
Chennai. India

S.Godwin Barnabas
St.Joseph's College of Engineering
Chennai. India.

***Abstract*- With obsolescence rates on the rise the question as to what the user ultimately does with the end-of-life (EOL) product becomes an issue that has both environmental and economic implication. An important concern in EOL management for electronic products is to connect the equipment owners with potential buyers who may be interested in their EOL items, whether for reuse, component retrieval or material recovery. There is an estimate that the total obsolete computers originating from government offices, business houses, industries and household is of the order of 2.5 million numbers per year. Manufacturers and assemblers in a single calendar year are estimated to produce around 1500 tons of electronic scrap. One of the important problems faced by the top management in the computer hardware industries is the evaluation of various alternatives for EOL computers. The paper aims at linking the various issues of the reverse logistics in a single systematic framework for the selection of an alternative for the reverse logistics operations for EOL computers. The utility of the Analytic network process (ANP) in integrating both quantitative as well as the qualitative characteristics and using C++ as the platform for arriving at the best possible solution proves to be more realistic and accurate.**

Keywords: end-of-life, obsolescence, analytic network program, alternatives, reverse logistics.

I. INTRODUCTION

Reverse logistics is the process of planning, implementing and controlling the efficient, cost effective low of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal [1]. A reverse logistics defines a supply chain that is redesigned to efficiently manage the flow of products or parts destined for remanufacturing, recycling, or disposal and to effectively utilize resource. According to a recent study, reverse logistics is one of the twenty one top warehousing trends in the twenty first century (Brockmann,1999). Industries have started to realize that the reverse logistics can be used to gain competitive advantage. An evaluation framework, which incorporates determinants and dimensions of reverse logistics, would be useful in configuring the post activities associated with the EOL computers. There are number of variables affecting the reverse logistics, some of these are interdependent among each other.

Analytic Network Process (ANP) is a technique that captures the interdependencies between the criteria under consideration, hence allowing for a more systematic analysis [2]. It can allow inclusion of criteria, both tangible and intangible, which has some bearing on making the best decision. Further, many of these factors have some level of interdependency among them, thus making ANP modeling better fit for the problem under study. The ANP model presented in this paper structures the problem related to selection of an alternative for the reverse logistics option for EOL computers in a hierarchical form and links the determinants, dimensions and enablers of reverse logistics with different alternatives.

II. LITERATURE REVIEW

Stock (1992) recognized the field of reverse logistics as being relevant for business and society in general. Kopicki, Berg, Legg, Dasappa, and Maggioni (1993) paid attention to the field and pointed out opportunities on reuse and recycling. Fleischmann, Bloemhof-Ruwaard, Dekker, van der Laan, van Nunen, and Van Wassenhove (1997) had given a comprehensive review of literature of the quantitative models in reverse logistics. Reverse logistics programs in addition to the various environmental and the cost benefits can proactively minimize the threat of government regulation and can improve the corporate image of the companies (Carter & Ellram, 1998). Reverse logistics is the process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal (Rogers & Tibben-Lembke, 1998). A reverse logistics defines a supply chain that is redesigned to efficiently manage the flow of products or parts destined for remanufacturing, recycling, or disposal and to effectively utilize resources (Dowlatshahi, 2000).

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Thus, the reverse logistics focuses on managing flows of material, information, and relationships for value addition as well as for the proper disposal of products. Reverse logistics has been used in many industries like photocopiers (Krikke, van Harten, & Schuur, 1999a; Thierry, Salomon, Nunen, & Wassenhove, 1995; van der Laan, Dekker, & Van Wassenhove, 1999) single-use cameras (Toktay, Wein, & Stefanos, 2000), jet engine components (Guide & Srivastava 1998), cellular telephones (Jayaraman, Guide, & Srivastava, 1999), automotive parts (van der Laan, 1997) and refillable containers (Kelle & Silver, 1989). In all the cases, one of the major concerns is to assess whether or not the recovery of used products is economically more attractive than the disposal of the products [3]. Reverse logistics are also extensively practiced in the computer hardware industry. IBM and Dell Computer Corporation have embraced reverse logistics by taking steps to streamline the way they deploy old systems; and in the process make it easier for the customers to refurbish existing computers or buy new parts (Ferguson, 2000). Grenchus, Johnson, and McDonell (2001) reported that the Global Asset Recovery Services (GARS) organization of IBM's Global Financing division has integrated some of the key components of its reverse logistics network to support and enhance environmental performance. Moyer and Gupta (1997) have conducted a comprehensive survey of previous works related to environmentally conscious manufacturing practices, recycling, and the complexities of disassembly in the electronics industry. Gungor and Gupta (1999) have presented the development of research in environmentally conscious manufacturing and product recovery (ECMPRO) and provided a state-of-the-art survey of the published work in this area. Veerakamolmal and Gupta (1997) have discussed a technique for analyzing the design efficiency of electronic products, in order to study the effect of end-of-life disassembly and disposal on environment. Nagel and Meyer (1999) discuss a novel method for systematically modeling end-of-life networks and show ways of improving the existing and new systems with ecological and economical concerns. Boon, Isaacs, and Gupta (2002) have investigated the critical factors influencing the profitability of end-of-life processing of PCs. They also suggested suitable policies for both PC manufacturers and legislators to ensure that there is a viable PC recycling infrastructure. Lambert (2003) presented a state-of-the-art survey of recently available literature on disassembly sequencing and the papers closely related to this topic. Krikke, van Harten, and Schuur (1999b) have discussed a case of the recycling PC-monitors as a part of a broader pilot project at Roteb (the municipal waste company of Rotterdam, The Netherlands) where by using the model developed, it achieved a reduction of recycling costs by about 25%. Ferguson and Browne (2001) discussed the issues in EOL product recovery and reverse logistics. Knemeyer, Ponzurick, and Logar (2002) utilized a qualitative methodology to examine the feasibility of designing a reverse logistics system to recycle or refurbish EOL computers that are deemed no longer useful by their owners [7]. From the literature review, it is observed that there is not much work reported till date for multi-criteria decision making in the decision making related to reverse logistics practices in the case of EOL computers.

III. PROBLEM DESCRIPTION

Reverse logistics have recently received much attention as most of the companies are using it as a strategic tool to serve their customers and can generate good revenue. It is a vital part of a successful business in warehousing and distribution. Recognizing that both the forward and reverse channels of the supply chain can be combined and doing this correctly will save a significant amount of money for the business.

The representation of the model and decision environment clearly shows that the overall objective is to carry out reverse logistics processes for EOL computers. The determinants of reverse logistics (economic factors, legislation, business strategy and customer service initiatives) are modeled to have dominance over the dimensions of reverse logistics. The reverse logistics attribute enablers are those that assist in achieving the controlling dimension of reverse logistics. Thus these are dependent on the dimension. Also, there are some interdependencies among the enablers. The reverse logistics implementation alternatives in this model are the specific projects or policies that a decision maker wishes to evaluate, given the various attribute levels of the reverse logistics. The various alternatives available to the decision maker in this case include third party reverse logistics, Self Support Logistics and Virtual reverse logistics network.

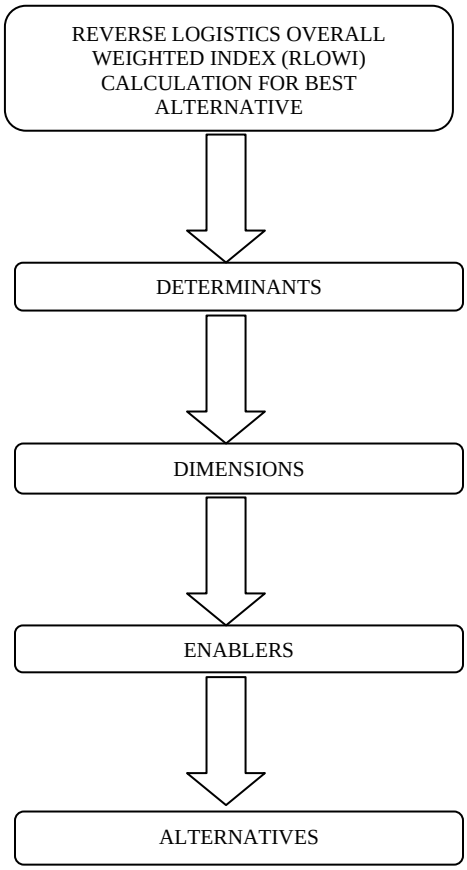


Fig.1.ANP model for EOL Computers

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

IV. METHODOLOGY

The case study approach was selected because it is an ideal method when a holistic, in-depth investigation is needed. This case study approach helps to gather the facts from the real world and explain the linkages between causes and effects. One such benefit is that the information provided is usually more concrete and contextual, specifically due to the in depth analysis it offers of the case being studied.

A. Algorithm

Step 1: Start

Step 2: Model development and problem formulation

Step 3: Pair-wise comparison of determinants

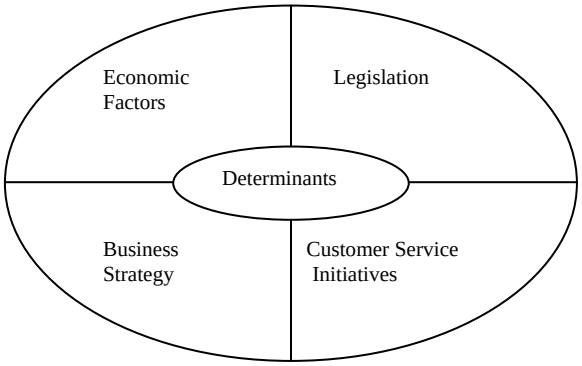


Fig.2. Determinants

Step 4: Pair-wise comparison of dimensions for each determinants

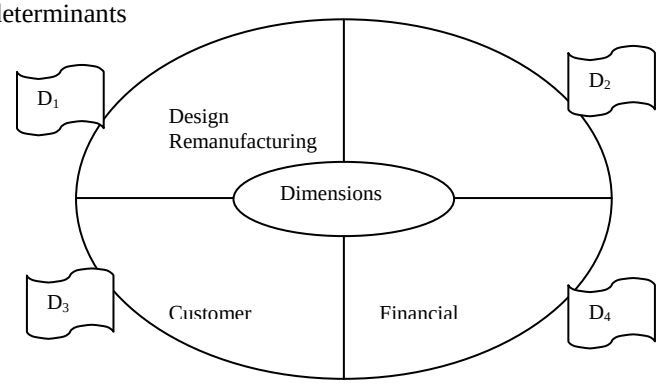


Fig.3. Dimensions

Step 5: Pair-wise comparison matrices between component /enablers levels

D_1	D_2	D_3	D_4
Uncertainity Modeling(UM)	Demand Forecasting(DF)	Convenience(CON)	Waste Reduction (WR)
Management of Collection Centers(MCC)	Forecasting cost(FS)	Green Products(GP)	Cost Savings (CSA)
Impact of Transportation(IT)	Remanufacturing cost(RC)	Customer Satisfaction(CSF)	Recapturing Value (REV)

Table .1. Enablers with respect to the Dimensions

Two components would be compared at a time with respect to an upper level control criterion. The pair-wise comparisons of the elements at each level are conducted with respect to their relative influence towards their control criterion. For a Determinant, Pair-wise comparison is done between the applicable enablers within a given dimension cluster.

Step 6: Pair-wise comparison matrices of interdependencies among the enablers

Step 7: Evaluation of alternatives

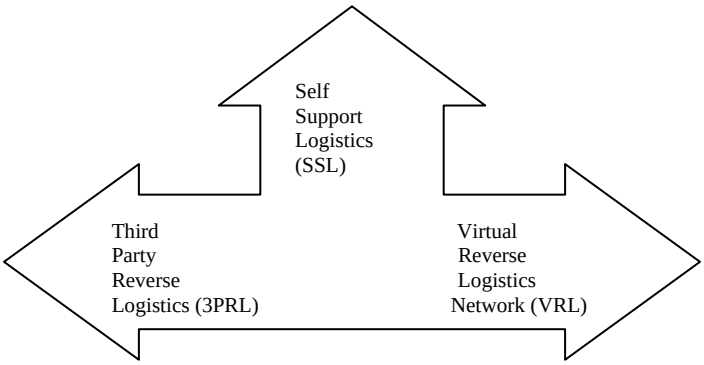


Fig.4.Alternatives

Step 8: Develop Super matrix from Pair-wise comparison matrices of interdependencies

Step 9: Selection of the best alternative for a determinant

Step 10: Calculation of reverse logistics overall weighted index (RLOWI)

Step 11: Stop

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

V. CASE ILLUSTRATION

The model presented in this paper has been evaluated in an actual computer manufacturing company, which was interested in the implementation of the reverse logistics practices.

A. Main function of the ANP implementation program

```
void main()
{  int i,k,n=0,j;
 float detevect[20]={0},rlowii[20]={0};
 float rlowic=0, rlowin[10]={0};
 float
det[4][4]={1,6,5,3,0.1667,1,3,2,0.2,0.333,1,2,0.333,0.5,0.5,1};
 cout<<"\n\t\t DETERMINANTS\n\n";
float * evectordet=evectformation(det);
   for( k=0;k<3;k++)
 {          detevect[k]=*(evectordet+n);
             n++;                                    }
   float * edi=economicfactors();
 for( k=0;k<3;k++)
 {          rlowi[k][0]=*(edi+n);
             n++;                          }
float * ldi=legislation();
  for( k=0;k<3;k++)
 {          rlowi[k][1]=*(ldi+n);
             n++;                                }
 float * bdi=businessstrategy();
 for( k=0;k<3;k++)
 {          rlowi[k][2]=*(bdi+n);
             n++;                                    }
 float * cdi=customerserviceini();
 for( k=0;k<3;k++)
 {          rlowi[k][3]=*(cdi+n);
             n++;                                      }
for(i=0;i<3;i++)
 {  for(k=0;k<4;k++)
       { cout<<rlowi[i][k]<<"  ";                    }
      cout<<"\n";                                     }
for(i=0;i<3;i++)
 {        rlowii[i]=0.0;
            for(k=0;k<4;k++)
          {     rlowii[i]+= detevect[k]* rlowi[i][k];      }}
cout<<"\n\t\t REVERSE LOGISTICS OVERALL
WEIGHTED INDEX \n\n";
for( i=0;i<3;i++)
  {          cout<<rlowii[i]<<"\n";                      }
  for(i=0;i<3;i++)
 {            rlowic+=rlowii[i];                      }
 for(j=0;j<3;j++)
{           rlowin[j]=(rlowii[j]/rlowic);                  }
cout<<"\n\t\t NORMALISED VALUE  OF REVERSE
LOGISTICS OVERALL WEIGHTED INDEX \n\n";
for(i=0;i<3;i++)
  {     cout<<rlowin[i]<<"\n";                        }  }
```

B. Super Matrix

	UM	MCC	IT	DF	FS	RC	CON	GP	CSF	WR	CSA	REV
UM	0	0.14	0.14									
MCC	0.86	0	0.86									
IT	0.14	0.86	0									
DF				0	0.83	0.8						
FS				0.2	0	0.2						
RC				0.8	0.17	0						
CON							0	0.86	0.83			
GP							0.83	0	0.17			
CSF							0.17	0.14	0			
WR										0	0.86	0.2
CSA										0.86	0	0.8
REV										0.14	0.14	0

Table.2. Super matrix

C. RLOWI calculation for alternatives

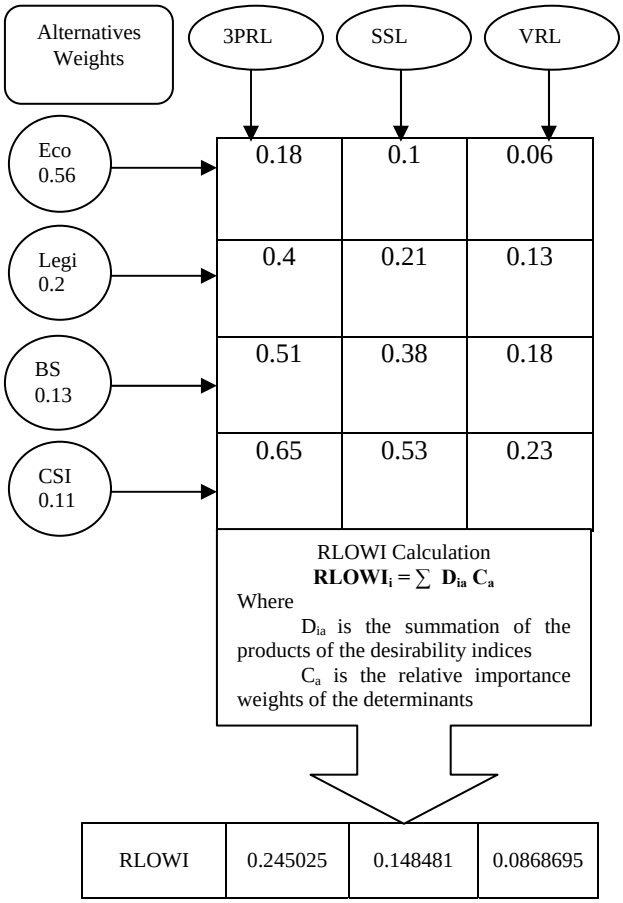


Fig.5. RLOWI calculation for alternatives

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

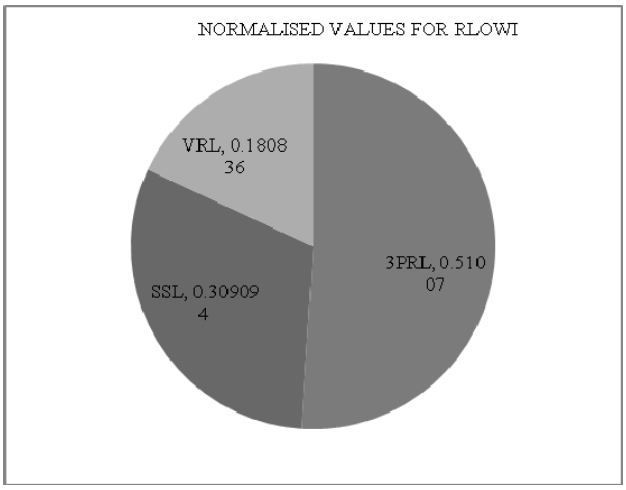


Fig.6. Normalised Values for RLOWI

VI. Conclusion

The reverse logistics practices may cost in millions of dollars for company. The implementation of these may be a risky endeavor for the top management as it involves financial and operational aspects, which can determine the performance of the company in the long run. However, with the legislative measures tightening up, there are not many options. The question now is not whether to go for it or not but which framework to pick up.

For the case undertaken in this study, the results indicate that Third party reverse logistics (3PRL) is the first choice of the case company which is followed by self support logistics (SSL) and Virtual reverse logistics network (VRL).

Growing complexity of the logistics function and increased impetus on core competence has led the company under study to outsource logistics activities to third party reverse logistics providers as the value of this alternative is higher(0.510107) than the other two alternatives. Another important factor influencing the adoption of 3PRL is globalization.

The major contribution of this paper lies in the development of a comprehensive model, which incorporates diversified issues for conducting reverse logistics operations for EOL computers. The C++ program developed for the execution of the above ANP problem is more flexible, that it can be used for any other type of industry under study.

VII. References

[1] He, B., Yang, C., Ren, M. M. A Fuzzy Multi-objective programming for optimization of reverse logistics for solid waste through genetic algorithms. *In Fourth international conference on fuzzy systems and knowledge discovery*. China 2007, pp. 416-420.

[2] Kärkkäinen, M. Increasing efficiency in the supply chain for short shelf life goods using RFID tagging. *International Journal of Retail and Distribution Management*, 31(10), 2003, pp 526-536.

[3] Lee, D. H., & Dong, M. A heuristic approach to logistics network design for end-of-lease computer products recovery. Transportation Research Part E: Logistics and Transportation Review, 44(3), 2008, pp 455-474.

[4] Caruso, C., Colorni, A., & Paruccini, M. . The regional urban solid waste management system: A modeling approach. *European Journal of Operational Research*, 70(1), 1993, pp 16-30.

[5] Aras, H., Erdogmus, S., & Koc, E. Multi-criteria selection for a wind observation station location using analytic hierarchy process. *Renewable Energy*, 29, (2004) pp 1383-1392.

[6] Bian, W., & Yu, M.. Location analysis of reverse logistics operations for an international electrical manufacturer in Asia Pacific using the analytic hierarchy process. *International Journal of Services Operations and informatics*, 1 (1/2), 187-201. *Management and Decision Making*, 9 (4), (2006), 350-365.

[7] V.Ravi, Ravi Shankar & M.K.Tiwari, Analyzing alternatives in reverse logistics for end-of-life computers: ANP and balanced scorecard approach, *Computers & Industrial Engineering* 48,(2005),pp 327-356.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

Implementation of Direct Processor Access in Transient Nodes

P. S. BALAMURUGAN,

Research Scholar ,

Anna University of Technology,

Coimbatore .

K.THANUSHKODI,

Director ,

Akshaya College of Engineering and Technology,

Coimbatore.

***Abstract*- Wireless sensor networks faces a number of challenges; a wireless sensor network which includes a number of sensor nodes must provide reliability and fault tolerance against a number of odds such as scalability, hardware, environmental conditions, power and energy factors. In this paper, we address these two issues of Reliability and Fault Tolerance using mirror nodes. We demonstrate that increased reliability can be achieved by using mirror nodes and the costs could be maintained by implementing the Direct Processor Access(DPA). Experimental results on the benchmarks data set show that our proposed system based on Direct Processor Access outperforms the other well-known methods such as the Distributed Deviation Detection, Distributed anomaly detection, Intrusion detection for routing attacks, Statistical en route filtering and Abnormal Relationship Tests(ART). The improvement in performance using DPA is very high, particularly, for the graphical and network processes (6.8 percent improvement). Statistical Tests also demonstrate higher fault tolerance and improvement in performance for our method. Finally, we show that our system is robust and is able to handle faulty sensor nodes without compromising performance.**

***Keywords* -Wireless Sensor Networks,;Faulty Sensor Nodes; Fault Tolerance; Direct Processor Access ;Mirror Nodes**

I. INTRODUCTION

A wireless sensor network (WSN) is a collection of nodes organized in a network where each node consists of one or more microcontrollers, CPU's or DSP chips, a memory and a RF transceiver, a power source such as battery. It also accommodates various sensors and actuators. The nodes communicate without wire (wireless) and often organize itself after being deployed in an ad hoc fashion . The intrinsic properties of individual sensor nodes pose additional challenges to the communication protocols in terms of energy consumption.

The reliability or fault tolerance is yet another issue. Some sensor nodes may fail or be blocked due to lack of power, physical damage or environmental interference. The failure of sensor nodes should not affect the overall task of the sensor network.

A. Challenges of Wireless Sensor Networks

In monitoring sensor networks, data coming from various streams of the sensor nodes have to be examined dynamically and combined into normal patterns in order to detect potential anomalies. Due to the requirement for the support of mission critical applications in many cases, the sensors must possess mechanisms for securing communications and for validating the collected data. Several attack scenarios that exploit the weaknesses of WSNs has been identified and the scale of deployments of WSNs requires careful decisions and tradeoffs among various security measures. These issues are taken into consideration and mechanisms to achieve a higher level of security and reliability has been proposed in these networks.

II. WIRELESS SENSOR NETWORK WITH MIRROR NODES

In this investigation, we assign a mirror node for each master node. At a time only a single node will be activated, either master node or mirror node. The mirror node will be in active state only in the absence of the master node. Whenever master node is identified as faulty node, the primary node will activate the mirror node and isolate the master node from the sensor network. This process helps to improve the availability of the sensor networks during threats and disaster and its performance is shown in Fig 1.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

TABLE 1: PERFORMANCE OF SENSOR NETWORK WITH MIRROR NODES

Data Transmission rate in sensor network with mirror nodes (MB/ s)	**Data Transmission rate in sensor network without mirror nodes(MB/s)**
0.2	0.1
0.4	0.22
0.45	0.33
0.52	0.34
0.56	0.41
0.59	0.42
0.61	0.43
0.67	0.46
0.69	0.51
0.74	0.52
0.78	0.54

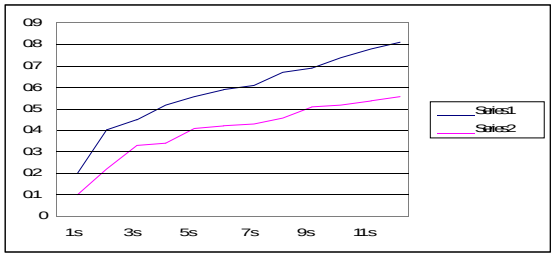


Figure 1:Performance of sensor network with mirror nodes

In the previous investigation, the availability of the sensor networks was increased to the optimum level. But the sensor networks consist of a large number of sensor nodes and implanting a mirror node for each individual sensor node will increase the overall cost of the networks.

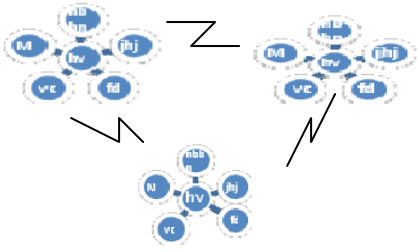


Figure 2: Structure of Sensor node with asynchronous mirror node

If the cost of the network is more expensive than deploying traditional sensors, then the sensor network is not cost justified. we have formulated two approaches for allocating monitor node for a cluster. Clustering can be structured asymmetrically or symmetrically. In asymmetric clustering, one machine is in non dedicated mode while the other is acquiring real time data. The non dedicated host does nothing but simply monitors the remaining nodes in the cluster. If any node fails, then the non dedicated host becomes the active node. In the second approach, two or more hosts are monitoring each other. If any node in the co-operating system fails, then the monitoring nodes share the workload of faulty nodes among them. These approaches are useful where maximum reliability and availability are required and its performance is shown in fig 3.

TABLE 2: PERFORMANCE OF SENSOR NETWORK WITH ASYNCHRONOUS MIRROR NODES

Data Transmission rate in sensor network with Asynchronous mirror (MB/s)	**Data Transmission rate in sensor network without Mirror nodes (MB/ s)**
0.19	0.1
0.35	0.22
0.412	0.33
0.452	0.34
0.516	0.41
0.58	0.42
0.59	0.43
0.64	0.46
0.656	0.51
0.714	0.52
0.728	0.54
0.781	0.56

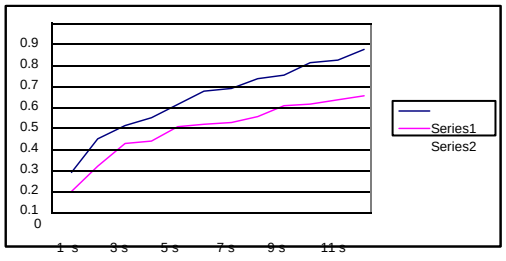
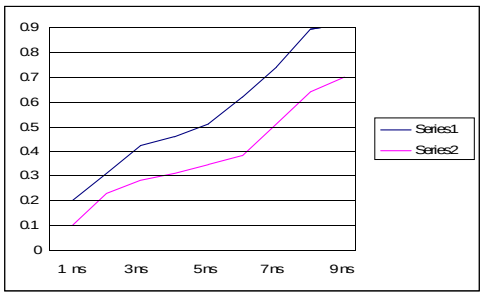


Figure 3: Performance graph for asymmetric mirror nodes

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

TABLE 3: COMPARISON OF TIME DELAY FOR A SENSOR NETWORK WITH ASYNCHRONOUS MIRROR NODE AND WITHOUT MIRROR NODE

Time delay for a sensor network without mirror in sensor network (ns)	**Time delay for a sensor network with asynchronous mirror in sensor network (ns)**
0.2	0.1
0.31	0.23
0.42	0.28
0.46	0.31
0.51	0.344
0.62	0.38
0.74	0.51
0.89	0.64
0.916	0.7



Figre 4: Time delay for a sensor network having mirror node and without mirror node

From these comparisons we could conclude that introducing mirror nodes will obviously improve the performance of sensor networks. Hence sensor networks with mirror nodes can be implemented in real time systems where time constraints are strictly followed and cost factor is not an issue.

III. DPA in Sensor Network

To increase the accessing speed and to attain an efficient memory access, a new methodology is employed in the proposed system. The methodology is termed as Array Methodology. By this methodology the processor will interact with the RAM device in an array fashion by which the RAM will be divided into arrays and each array will be allotted for a default program to be utilized. Thus the processor can access the data and codes easily, by searching in the specified memory location. By this procedure the value n will not represent the total cache memory space but it will represent only the value of an array. When a program needs more memory space than the allotted memory by using artificial intelligence we can combine the memory and utilize it to execute the program. The process of combining memory can be done by calculating the frequently used program or FIFO method. This method is highly applicable when we need to run a program which needs memory space less than n/11 in a high RAM capacity machine. In this methodology the work of the processor is simplified by allowing it to search in the allotted array.

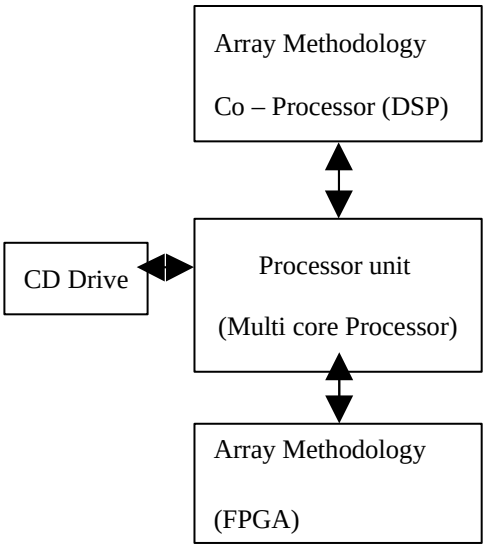


Figure 5: Block Diagram of Array methodology Based Co - Processor Design

Another important concern that influences the processor performance is the heat sink designed for the IC and the design has to be chosen between its size and performance. The impact of CMOS technologies on substrate and metal line temperatures have resulted in improved reliability and better performance of the devices and interconnections. 74 % of processor failures are due to thermal factors and high power sources such as power dissipation, temperature relation, a method for full chip temperature calculation and implications on the design of high performance low power VLSI circuits. By spacing the memory in an array manner, the cache port's accessibility could be improved. This can be known from the percentage of hit ratio tabulated for the different programs.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

In the existing system, the faulty node is identified and isolated from the network by using the statistically available tools. The erroneous data due to faulty nodes may become an issue if any real time system does depend on the output of sensor. The delay or erroneous data will become a hectic issue where small delays or erroneous data will result the entire system to get fail. Moreover in real time applications, several hundreds to thousands of nodes are deployed throughout the sensor field. The introduction of a mirror node to each cluster of nodes will increase the total number of nodes to maximum. So instead of going for a separate node for each cluster, we intend to use Direct Processor Access (DPA) as mirror node so as to utilize the sensor node to perform the sensor related task and console application task simultaneously. Also more number of processors could be embedded in the DPA in executing the console and real time applications thus improving parallelism. There incurred some overhead while implementing multi core processors within a system because of high IO and context switch between the processors for resources. The DPA should also be designed in such a way that should control the remaining processors in the sensor networks. Moreover security issues must be considered while implementing multiple processors in DPA, as it belongs to a network leading to more possibilities for security threats. The performance of sensor networks has been increased by implementing DPA as mirror nodes and by utilizing FPGA and DSP Processor in DPA.

The hit ratio in a non-dedicated multi processor is comparatively higher than that of a single processor and the accessing time is efficient for a program which has a minimum capacity of Random Access Memory. In our proposed system the mirror node is replaced by a FPGA processor in the network so that the sensor node will perform more than one task simultaneously. One is to gather data and that task depends on the application of sensor network. The other task is to monitor the remaining nodes in the network. Hence the cost to mirror node ratio will decrease drastically and also the performance of the sensor network will increase to the optimum level because of parallel processing done by FPGA. In addition to the monitoring task, FPGA can also perform some application specific tasks during its leisure time. By making FPGA processor to execute some application specific tasks, it always stays in the busy state and never remains idle. Hence by implanting FPGA processor in sensor node, console application as well as sensor specific tasks could be done in parallel. We propose a new approach in which data gathered from sensor nodes are shared among different computers in cloud computing where data owners can remotely store their data in the cloud to enjoy high quality applications and services from a shared pool of configurable computing resources. The sensor nodes which are deployed to study the phenomenon may be in the order of hundreds or thousands. Depending on the application, the number may reach extreme values of millions. The new scheme must be able to work with these extreme numbers of nodes. Since the sensor networks consist of a large number of sensor nodes, the cost of a single node is very important to justify the overall cost of the networks. If the cost of the network is more expensive than deploying traditional sensors, then the sensor network is not cost justified. As a result, the cost of each sensor node has to be kept low which results in low quality sensors to be deployed and hence results in less performance.

IV. CONCLUSION

From the above results, we arrive at a conclusion that the introduction of mirror node either to a cluster of nodes or to each sensor node will result in increasing the performance of the sensor network and also the availability is increased to a maximum level. The method of introducing mirror node for each sensor node is not suitable for commercial application due to high cost factor. In systems where cost factor is an issue the later can be opted to improve the performance of the system. To overcome the difficulty that incurred due to high cost, we proposed a system, where a single node (DPA) is allocated for monitoring the remaining nodes in the cluster. If any of the monitored nodes produced anomalous data, then the faulty node would be isolated from the network and the monitoring node will take charge performing the tasks that needs to be done by the faulty node. Thus implementing substitute node for each cluster will improve the reliability of the sensor network and makes the sensor to work more efficiently in real time systems where strict constraints are followed to make the system work correctly.

This proposed system is designed for a static sensor network. It makes use of substitution nodes to ensure continuous flow of data even in case of base node failure. Also work can be done by using a scalable network to increase the performance. Cloud computing could also be made use of, which offers many benefits, such as flexibility and instant access to the latest data and applications. But there are also risks, such as the dependency on high availability, high performance network connections, and not to forget about the least security and privacy.

REFERENCES

[1] E. Rohou and M. Smith, (1999), “Dynamically managing processor temperature and power,” *Proc. FDDO-2*

[2] S. I. Souri, K. Banerjee, A. Mehrotra, and K. C. Saraswat,(2000) “Multiple Si layer ICs: Motivation, performance analysis, and design implications,” *Proc Design Automation Conf.*, pp. 873-880.

http://sites.google.com/site/ijcsis/
ISSN 1947-5500

[3] S. Das, A. Chadrakasan, (2003) “Three-dimensional integrated circuits: performance, design methodology, and CAD tools,” *Proc. IEEE Annual Symp. on VLSI*,pp. 13-18.

[4] M.B. Kleiner, S. A. Kuhn, P. Ramm and W. Weber,(1995) “Thermal analysis of vertically integrated circuits.” *Tech. Dig. Int’l Electron Devices Meeting*, pp.487-490.

[5] A. Rahman, R. Reif, (2001) “Thermal analysis of three dimensional (3-D) integrated circuits (ICs),” *Proc.Int’l Interconnect Technology Conf.*, pp. 157-159.

[6] F. Fallah and M. Pedram,(2005) "Standby and active leakage current control and minimization in CMOS VLSI circuits." *IEICE Trans. on Electronics*, Special Section on Low-Power LSI and Low-Power IP, Vol. E88-C, No. 4, pp. 509-519.

[7] B. Chatterjee, M. Sachdev, S. Hsu, R. Krishnamurthy, and S. Borkar, (2003) “Effectiveness and scaling trends of leakage control techniques for sub-100nm CMOS technologies,” *Proc. Int’l Symp. Low-power Electronics*, pp. 122-127.

[8] M.L. Mui, K. Banerjee, A. Mehrota, (2004) “Power supply optimization in sub-130nm leakage dominant technologies,” *Proc. Int’l Symp. Quality Electronic Design*, pp. 409-414.

[9] Int’l Technology Roadmap for Semiconductors (ITRS), 2004.

[10]K. Banerjee, A. Mehrotra, A. Sangiovanni- Vincentelli, and C. Hu (1999) “On Thermal Effects in Deep Sub-Micron VLSl Interconnects,” *Proc. Design Automation Conf.* , pp. 885-891.

[11] H. J. M. Veendrick (1984) “Short-circuit dissipation of static CMOS circuitry and its impact on the design of buffer circuits,” *IEEE Journal of Solid-State Circuits*, vol. 19, pp. 468–473.

[12]A. Alvandpour, P.L. Edefors, C. Svensson, (1998) “Separation and extraction of short-circuit power consumption in digital CMOS VLSI circuits,” *Proc. Low Power Electronics and Design*, pp. 245-249.

[13]S. Turgis, N. Azemard, and D. Auvergne, (1996) “Explicit evaluation of short-circuit power dissipation and its influence on propagating delay for static CMOS gates,” *Proc. IEEE Int. Symp. on Circuits and Systems*,vol. 4, pp. 751-754.

[14]S.H. Jung, J.H. Baek, S.Y. Kim, (2001) “Short circuit power estimation of static CMOS circuits,” *Proc. Asia- Pacific Design Automation Conf.*, pp. 545-549.

AUTHORS PROFILE

Author 1

Prof. P.S.Balamurugan

Assistant Professor,

Department of Electronics and Communication

Engineering, Karpagam College of Engineering,

Coimbatore , Tamil Nadu, India.

P.S.Balamurugan received BE degree in 2003 from Bharathiyar University, Coimbatore and ME in 2005 from Anna University Currently He is pursuing his Doctoral degree at Anna University of Technology, Coimbatore. He is working as Assistant Professor at Karpagam College of Engineering, Coimbatore.

Author 2

Dr. K.Thanushkodi

Director , Akshya College of Engineering,

Coimbatore, Tamil Nadu, India.

Dr. K.Thanushkodi is the Director of Akshya College of Engineering Coimbatore , Tamil Nadu, India. He received BE degree in Electrical and Electronics Engineering from Madras University, Chennai. MSc (Engg) from Madras University, Chennai and Doctoral degree in Electrical and Electronics Engineering from Bharathiar University, Coimbatore.

IJCSIS REVIEWERS' LIST

Assist Prof (Dr.) M. Emre Celebi, Louisiana State University in Shreveport, USA

Dr. Lam Hong Lee, Universiti Tunku Abdul Rahman, Malaysia

Dr. Shimon K. Modi, Director of Research BSPA Labs, Purdue University, USA

Dr. Jianguo Ding, Norwegian University of Science and Technology (NTNU), Norway

Assoc. Prof. N. Jaisankar, VIT University, Vellore,Tamilnadu, India

Dr. Amogh Kavimandan, The Mathworks Inc., USA

Dr. Ramasamy Mariappan, Vinayaka Missions University, India

Dr. Yong Li, School of Electronic and Information Engineering, Beijing Jiaotong University, P.R. China

Assist. Prof. Sugam Sharma, NIET, India / Iowa State University, USA

Dr. Jorge A. Ruiz-Vanoye, Universidad Autónoma del Estado de Morelos, Mexico

Dr. Neeraj Kumar, SMVD University, Katra (J&K), India

Dr Genge Bela, "Petru Maior" University of Targu Mures, Romania

Dr. Junjie Peng, Shanghai University, P. R. China

Dr. Ilhem LENGLIZ, HANA Group - CRISTAL Laboratory, Tunisia

Prof. Dr. Durgesh Kumar Mishra, Acropolis Institute of Technology and Research, Indore, MP, India

Jorge L. Hernández-Ardieta, University Carlos III of Madrid, Spain

Prof. Dr.C.Suresh Gnana Dhas, Anna University, India

Mrs Li Fang, Nanyang Technological University, Singapore

Prof. Pijush Biswas, RCC Institute of Information Technology, India

Dr. Siddhivinayak Kulkarni, University of Ballarat, Ballarat, Victoria, Australia

Dr. A. Arul Lawrence, Royal College of Engineering & Technology, India

Mr. Wongyos Keardsri, Chulalongkorn University, Bangkok, Thailand

Mr. Somesh Kumar Dewangan, CSVTU Bhilai (C.G.)/ Dimat Raipur, India

Mr. Hayder N. Jasem, University Putra Malaysia, Malaysia

Mr. A.V.Senthil Kumar, C. M. S. College of Science and Commerce, India

Mr. R. S. Karthik, C. M. S. College of Science and Commerce, India

Mr. P. Vasant, University Technology Petronas, Malaysia

Mr. Wong Kok Seng, Soongsil University, Seoul, South Korea

Mr. Praveen Ranjan Srivastava, BITS PILANI, India

Mr. Kong Sang Kelvin, Leong, The Hong Kong Polytechnic University, Hong Kong

Mr. Mohd Nazri Ismail, Universiti Kuala Lumpur, Malaysia

Dr. Rami J. Matarneh, Al-isra Private University, Amman, Jordan

Dr Ojesanmi Olusegun Ayodeji, Ajayi Crowther University, Oyo, Nigeria

Dr. Riktesh Srivastava, Skyline University, UAE

Dr. Oras F. Baker, UCSI University - Kuala Lumpur, Malaysia

Dr. Ahmed S. Ghiduk, Faculty of Science, Beni-Suef University, Egypt
and Department of Computer science, Taif University, Saudi Arabia

CALL FOR PAPERS
International Journal of Computer Science and Information Security
IJCSIS 2011
ISSN: 1947-5500
http://sites.google.com/site/ijcsis/

International Journal Computer Science and Information Security, IJCSIS, is the premier scholarly venue in the areas of computer science and security issues. IJCSIS 2011 will provide a high profile, leading edge platform for researchers and engineers alike to publish state-of-the-art research in the respective fields of information technology and communication security. The journal will feature a diverse mixture of publication articles including core and applied computer science related topics.

Authors are solicited to contribute to the special issue by submitting articles that illustrate research results, projects, surveying works and industrial experiences that describe significant advances in the following areas, but are not limited to. Submissions may span a broad range of topics, e.g.:

Track A: Security

Access control, Anonymity, Audit and audit reduction & Authentication and authorization, Applied cryptography, Cryptanalysis, Digital Signatures, Biometric security, Boundary control devices, Certification and accreditation, Cross-layer design for security, Security & Network Management, Data and system integrity, Database security, Defensive information warfare, Denial of service protection, Intrusion Detection, Anti-malware, Distributed systems security, Electronic commerce, E-mail security, Spam, Phishing, E-mail fraud, Virus, worms, Trojan Protection, Grid security, Information hiding and watermarking & Information survivability, Insider threat protection, Integrity
Intellectual property protection, Internet/Intranet Security, Key management and key recovery, Language-based security, Mobile and wireless security, Mobile, Ad Hoc and Sensor Network Security, Monitoring and surveillance, Multimedia security ,Operating system security, Peer-to-peer security, Performance Evaluations of Protocols & Security Application, Privacy and data protection, Product evaluation criteria and compliance, Risk evaluation and security certification, Risk/vulnerability assessment, Security & Network Management, Security Models & protocols, Security threats & countermeasures (DDoS, MiM, Session Hijacking, Replay attack etc,), Trusted computing, Ubiquitous Computing Security, Virtualization security, VoIP security, Web 2.0 security, Submission Procedures, Active Defense Systems, Adaptive Defense Systems, Benchmark, Analysis and Evaluation of Security Systems, Distributed Access Control and Trust Management, Distributed Attack Systems and Mechanisms, Distributed Intrusion Detection/Prevention Systems, Denial-of-Service Attacks and Countermeasures, High Performance Security Systems, Identity Management and Authentication, Implementation, Deployment and Management of Security Systems, Intelligent Defense Systems, Internet and Network Forensics, Large-scale Attacks and Defense, RFID Security and Privacy, Security Architectures in Distributed Network Systems, Security for Critical Infrastructures, Security for P2P systems and Grid Systems, Security in E-Commerce, Security and Privacy in Wireless Networks, Secure Mobile Agents and Mobile Code, Security Protocols, Security Simulation and Tools, Security Theory and Tools, Standards and Assurance Methods, Trusted Computing, Viruses, Worms, and Other Malicious Code, World Wide Web Security, Novel and emerging secure architecture, Study of attack strategies, attack modeling, Case studies and analysis of actual attacks, Continuity of Operations during an attack, Key management, Trust management, Intrusion detection techniques, Intrusion response, alarm management, and correlation analysis, Study of tradeoffs between security and system performance, Intrusion tolerance systems, Secure protocols, Security in wireless networks (e.g. mesh networks, sensor networks, etc.), Cryptography and Secure Communications, Computer Forensics, Recovery and Healing, Security Visualization, Formal Methods in Security, Principles for Designing a Secure Computing System, Autonomic Security, Internet Security, Security in Health Care Systems, Security Solutions Using Reconfigurable Computing, Adaptive and Intelligent Defense Systems, Authentication and Access control, Denial of service attacks and countermeasures, Identity, Route and

Location Anonymity schemes, Intrusion detection and prevention techniques, Cryptography, encryption algorithms and Key management schemes, Secure routing schemes, Secure neighbor discovery and localization, Trust establishment and maintenance, Confidentiality and data integrity, Security architectures, deployments and solutions, Emerging threats to cloud-based services, Security model for new services, Cloud-aware web service security, Information hiding in Cloud Computing, Securing distributed data storage in cloud, Security, privacy and trust in mobile computing systems and applications, **Middleware security & Security features:** middleware software is an asset on
its own and has to be protected, interaction between security-specific and other middleware features, e.g., context-awareness, **Middleware-level security monitoring and measurement:** metrics and mechanisms for quantification and evaluation of security enforced by the middleware, **Security co-design:** trade-off and co-design between application-based and middleware-based security, **Policy-based management:** innovative support for policy-based definition and enforcement of security concerns, **Identification and authentication mechanisms:** Means to capture application specific constraints in defining and enforcing access control rules, **Middleware-oriented security patterns:** identification of patterns for sound, reusable security, **Security in aspect-based middleware:** mechanisms for isolating and enforcing security aspects, **Security in agent-based platforms:** protection for mobile code and platforms, Smart Devices: Biometrics, National ID cards, Embedded Systems Security and TPMs, RFID Systems Security, Smart Card Security, Pervasive Systems: Digital Rights Management (DRM) in pervasive environments, Intrusion Detection and Information Filtering, Localization Systems Security (Tracking of People and Goods), Mobile Commerce Security, Privacy Enhancing Technologies, Security Protocols (for Identification and Authentication, Confidentiality and Privacy, and Integrity), Ubiquitous Networks: Ad Hoc Networks Security, Delay-Tolerant Network Security, Domestic Network Security, Peer-to-Peer Networks Security, Security Issues in Mobile and Ubiquitous Networks, Security of GSM/GPRS/UMTS Systems, Sensor Networks Security, Vehicular Network Security, Wireless Communication Security: Bluetooth, NFC, WiFi, WiMAX, WiMedia, others

This Track will emphasize the design, implementation, management and applications of computer communications, networks and services. Topics of mostly theoretical nature are also welcome, provided there is clear practical potential in applying the results of such work.

Track B: Computer Science

Broadband wireless technologies: LTE, WiMAX, WiRAN, HSDPA, HSUPA, Resource allocation and interference management, Quality of service and scheduling methods, Capacity planning and dimensioning, Cross-layer design and Physical layer based issue, Interworking architecture and interoperability, Relay assisted and cooperative communications, Location and provisioning and mobility management, Call admission and flow/congestion control, Performance optimization, Channel capacity modeling and analysis, Middleware Issues: Event-based, publish/subscribe, and message-oriented middleware, Reconfigurable, adaptable, and reflective middleware approaches, Middleware solutions for reliability, fault tolerance, and quality-of-service, Scalability of middleware, Context-aware middleware, Autonomic and self-managing middleware, Evaluation techniques for middleware solutions, Formal methods and tools for designing, verifying, and evaluating, middleware, Software engineering techniques for middleware, Service oriented middleware, Agent-based middleware, Security middleware, Network Applications: Network-based automation, Cloud applications, Ubiquitous and pervasive applications, Collaborative applications, RFID and sensor network applications, Mobile applications, Smart home applications, Infrastructure monitoring and control applications, Remote health monitoring, GPS and location-based applications, Networked vehicles applications, Alert applications, Embeded Computer System, Advanced Control Systems, and Intelligent Control : Advanced control and measurement, computer and microprocessor-based control, signal processing, estimation and identification techniques, application specific IC's, nonlinear and adaptive control, optimal and robot control, intelligent control, evolutionary computing, and intelligent systems, instrumentation subject to critical conditions, automotive, marine and aero-space control and all other control applications, Intelligent Control System, Wiring/Wireless Sensor, Signal Control System. Sensors, Actuators and Systems Integration : Intelligent sensors and actuators, multisensor fusion, sensor array and multi-channel processing, micro/nano technology, microsensors and microactuators, instrumentation electronics, MEMS and system integration, wireless sensor, Network Sensor, Hybrid

Sensor, Distributed Sensor Networks. Signal and Image Processing : Digital signal processing theory, methods, DSP implementation, speech processing, image and multidimensional signal processing, Image analysis and processing, Image and Multimedia applications, Real-time multimedia signal processing, Computer vision, Emerging signal processing areas, Remote Sensing, Signal processing in education. Industrial Informatics: Industrial applications of neural networks, fuzzy algorithms, Neuro-Fuzzy application, bioInformatics, real-time computer control, real-time information systems, human-machine interfaces, CAD/CAM/CAT/CIM, virtual reality, industrial communications, flexible manufacturing systems, industrial automated process, Data Storage Management, Harddisk control, Supply Chain Management, Logistics applications, Power plant automation, Drives automation. Information Technology, Management of Information System : Management information systems, Information Management, Nursing information management, Information System, Information Technology and their application, Data retrieval, Data Base Management, Decision analysis methods, Information processing, Operations research, E-Business, E-Commerce, E-Government, Computer Business, Security and risk management, Medical imaging, Biotechnology, Bio-Medicine, Computer-based information systems in health care, Changing Access to Patient Information, Healthcare Management Information Technology. Communication/Computer Network, Transportation Application : On-board diagnostics, Active safety systems, Communication systems, Wireless technology, Communication application, Navigation and Guidance, Vision-based applications, Speech interface, Sensor fusion, Networking theory and technologies, Transportation information, Autonomous vehicle, Vehicle application of affective computing, Advance Computing technology and their application : Broadband and intelligent networks, Data Mining, Data fusion, Computational intelligence, Information and data security, Information indexing and retrieval, Information processing, Information systems and applications, Internet applications and performances, Knowledge based systems, Knowledge management, Software Engineering, Decision making, Mobile networks and services, Network management and services, Neural Network, Fuzzy logics, Neuro-Fuzzy, Expert approaches, Innovation Technology and Management : Innovation and product development, Emerging advances in business and its applications, Creativity in Internet management and retailing, B2B and B2C management, Electronic transceiver device for Retail Marketing Industries, Facilities planning and management, Innovative pervasive computing applications, Programming paradigms for pervasive systems, Software evolution and maintenance in pervasive systems, Middleware services and agent technologies, Adaptive, autonomic and context-aware computing, Mobile/Wireless computing systems and services in pervasive computing, Energy-efficient and green pervasive computing, Communication architectures for pervasive computing, Ad hoc networks for pervasive communications, Pervasive opportunistic communications and applications, Enabling technologies for pervasive systems (e.g., wireless BAN, PAN), Positioning and tracking technologies, Sensors and RFID in pervasive systems, Multimodal sensing and context for pervasive applications, Pervasive sensing, perception and semantic interpretation, Smart devices and intelligent environments, Trust, security and privacy issues in pervasive systems, User interfaces and interaction models, Virtual immersive communications, Wearable computers, Standards and interfaces for pervasive computing environments, Social and economic models for pervasive systems, Active and Programmable Networks, Ad Hoc & Sensor Network, Congestion and/or Flow Control, Content Distribution, Grid Networking, High-speed Network Architectures, Internet Services and Applications, Optical Networks, Mobile and Wireless Networks, Network Modeling and Simulation, Multicast, Multimedia Communications, Network Control and Management, Network Protocols, Network Performance, Network Measurement, Peer to Peer and Overlay Networks, Quality of Service and Quality of Experience, Ubiquitous Networks, Crosscutting Themes – Internet Technologies, Infrastructure, Services and Applications; Open Source Tools, Open Models and Architectures; Security, Privacy and Trust; Navigation Systems, Location Based Services; Social Networks and Online Communities; ICT Convergence, Digital Economy and Digital Divide, Neural Networks, Pattern Recognition, Computer Vision, Advanced Computing Architectures and New Programming Models, Visualization and Virtual Reality as Applied to Computational Science, Computer Architecture and Embedded Systems, Technology in Education, Theoretical Computer Science, Computing Ethics, Computing Practices & Applications

Authors are invited to submit papers through e-mail ijcsiseditor@gmail.com. Submissions must be original and should not have been published previously or be under consideration for publication while being evaluated by IJCSIS. Before submission authors should carefully read over the journal's Author Guidelines, which are located at http://sites.google.com/site/ijcsis/authors-notes .

ISSN 1947 5500